Value Engineering

FINAL REPORT

Blackfeet Community Water Project

Date: January 31, 2002

Conducted for The Blackfeet Nation
Rural Development/Rural Utilities Services, Bureau of Indian Affairs,
Environmental Protection Agency, Town of Browning
and East Glacier Park Water and Sewage District

EAST GLACIER PARK WATER and SEWAG

Bureau of Reclamation,
North Dakota

Dakotas Area Office, Bismarck,

Table of Contents

Executive Summary

The Blackfeet Tribal Business Council has applied to Rural Development for assistance in financing the Blackfeet Community Water Project. The proposed project is to construct a 3,000 gpm (4.3 MGD) intake structure, water treatment plant, and water distribution system (buried pipeline) to supply both Browning and East Glacier with drinking water utilizing water obtained from the Lower Two Medicine Reservoir, a source that offers an adequate water supply and that provides a significant amount of storage. The goal of the water treatment plant is to meet the present and future water quality standards set forth in the Safe Drinking Water Act Amendments. Water distribution mains will then be constructed to supply water to East Glacier and Browning. The anticipated cost of the project is approximately $13,151,235. Rural Development has been asked to provide approximately half of that amount. The Environmental Protection Agency (EPA), Indian Health Service, Blackfeet Housing, Economic Development Administration, and the Treasure State Endowment Program have all committed funding for or applications have been submitted for funding for this project. This project will be owned and operated by the Blackfeet Tribe, and will provide safe drinking water to the residents of East Glacier, as well as to the residents of Browning. Water for East Glacier will be purchased from the Tribe, and it is anticipated that the new treatment plant will also serve Glacier Park Inc., which would be a large consumer of treated water.

The Value Study Team met on September 24, 2001 for a five day study of the of the Blackfeet Community Water Project as presented in the Preliminary Engineering Report. The estimated cost of the baseline concept is $13,151,235. The Team developed seven proposals which are summarized in priority order below. If all the savings proposals are accepted, their maximum Life Cycle Cost savings potential is $ 1,146,511. Note, that in calculating the maximum potential savings, the cost of the study ($29,600) was deducted only once.

Proposals: The proposals are independent of all other proposals and could be accepted or rejected individually without affecting other proposals.

<u>Proposal No. 1A</u>. Browning Transmission Main Revision. The proposal calls for installing the smallest pipe sizes necessary to meet the design flow of 2,500 gpm. The estimated savings of this proposal are $500,000 before deducting any study and/or implementation costs.

<u>Proposal No. 1B</u>. Utilize depth of bury construction in lieu of line on grade construction. The proposal calls for utilizing the depth of bury construction technique. This requires the Contractor to maintain the minimum pipe cover required in the area and allows flexibility (within the ROW) for moving the alignment around unforeseen obstacles. The estimated savings of this proposal are $85,000 before deducting any study and/or implementation costs.

<u>Proposal No. 1C</u>. Decrease the size of the proposed 500,000 gallon water storage tank.
The cost of this tank was not included in the cost estimates of the “Preliminary Engineering Report.” However, the design team considered it as part of the project cost and presented cost savings. The proposal calls for constructing a smaller tank, sized on pump run time requirements. A 100,000 gallon tank with 50,000 gallons of operational storage would keep pump starts to less than once an hour and would generally provide long pump run times. The estimated savings of this proposal are $350,000 before deducting any study and/or implementation costs.

<u>Proposal No. 2A</u>. Calcium Hypochlorite Disinfection System. The proposal calls for utilizing hypochlorite for disinfection generated from calcium hypochlorite pellets, which will also help stabilize the product water with the addition of some lime. The estimated savings of this proposal are $35,205 before deducting any study and/or implementation costs.

<u>Proposal No. 2B</u>. Comparison of pretreatment option for the micro-filtration system. Details of the roughing

filter considered in the original concept were not included in the Preliminary Engineering Report. The proposal considered a cartridge filter to remove the larger suspended solids. The estimated savings of this proposal are $35,205 before deducting any study and/or implementation costs.

Proposal No. 3. Minimize need for backup emergency power. The proposal calls for utilizing the capacity in water storage tanks and transmission mains to supply East Glacier and Browning with a minimum of one day average design flow during a power outage. Use generator at the water treatment plant to power controls and basic building operation. The estimated savings of this proposal are $71,803 before deducting any study and/or implementation costs.

Proposal No. 4. Intake structure, intake pipeline and raw water pipeline to water treatment plant. The proposal calls for constructing the intake line into Two Medicine Lake, installing four wells, casing/pumps/valves, construct pump control building and transmission line to water treatment plant. The estimated savings of this proposal are $46,239 before deducting any study and/or implementation costs.

Other Ideas: The Team identified 80 additional ideas for further consideration and development that are listed in the "Disposition of Ideas", page 60. A few of the more significant items are discussed in more detail in the "Additional Items for Further Study", page 68.

Value Study Team Members

Name/Title/Discipline	Address/Phone Number
Mr. Ted Hall Value Study Team Leader Civil Engineer	Bureau of Reclamation, Pierre Field Office 810 West Fifth Street, Pierre SD 57501 **Phone:** 605-945-2980 Ext. 3003 **Fax**: 605-945-2969 **E-mail:** thall@gp.usbr.gov
Ms. Karen Bucklin-Sanchez, PE Engineer, Rural Utilities Service	USDA MT Rural Development 900 Technology Boulevard, Suite B, Bozeman, MT 59718 **Phone:** 406-585-2528 **Fax**: 406-585-2565 **E-mail:** karen.sanchez@mt.usda.gov
Mr. Jason Lovett, PE Senior Environmental Engineer	Indian Health Service4020 Wheaton Way, Building B, Suite L, Bremerton, WA 98310**Phone:** 360-792-1235 **Fax**: 360-792-1314 **E-mail:** jason.lovett@mail.ihs.gov
Mr. Stewart Miller Project Manager	Blackfeet Community Water Project Quarters 108 N. Government Square, Browning, MT 59417 **Phone:** 406-338-7406 ext. 368 **Fax**: 406-338-7426 **E-mail:** ssm@3rivers.net
Mr. Dan Carney Biologist	Blackfeet Fish and Wildlife N. Government Square, Main Tribal Building, Browning, MT 59417 **Phone:** 406-338-7207 ext. 317 **Fax**: 406-338-7530 **E-mail:** dcarney@3rivers.net
Mr. John Monroe Project Coordinator	Blackfeet Housing 635 S. W. Boundary, Browning, MT 59417 **Phone:** 406-338-5031406-338-2241 **E-mail:** jmonroe@3rivers.net
Mr. Robert DesRosier Director	Blackfeet Utilities N. Government Square, Main Tribal Building Browning, MT 59417 **Phone:** 406-338-7667 ext. 302 **Fax**: 406-338-7451 **E-mail:** rjdrosi@3rivers.net
Ms. Michelle Chapman Physical Scientist	Bureau of Reclamation, PO Box 25007 (D-8230), Denver, CO 80225-0007 **Phone:** 303-445-2264 **Fax:** 303-445-6329 **E-mail:** mchapman@do.usbr.gov
Mr. Dennis Baker Director of Engineering	Glacier Park Inc. 1 Midvale, East Glacier, MT 59434 **Phone:** 406-226-5528 **Fax:** 406-226-9332 **E-mail:** baker@3riversnet

Project Description

The information contained in this brief summary description was taken in whole or in part from the *Preliminary Engineering Report - Blackfeet Community Water Project - April 25, 2001, Environment Assessment - Blackfeet Community Water Project - August 2001* and *Biological Assessment - Blackfeet Community Water Project.*

Background Information

The project area is located on the western edge of the Blackfeet Indian Reservation in Northwestern Montana. The immediate area to be served by the proposed project is the Town of Browning, the surrounding Tribal Housing Projects, and the community of East Glacier. Browning is located in the west-central portion of the Blackfeet Indian Reservation, and is the government seat of the Blackfeet Nation. East Glacier is located in the SW corner of the Blackfeet Indian Reservation, Figure 1. Major points of elevation include Lower Two Medicine Reservoir at 4882 feet, East Glacier from 4774 to 4840 feet and the overflow of the 100,000-gallon storage tank at 4979 feet. The Town of Browning is at approximately 4400 feet in elevation. The overflow elevation of the 1 million gallon storage tank in Browning is 4521 feet.

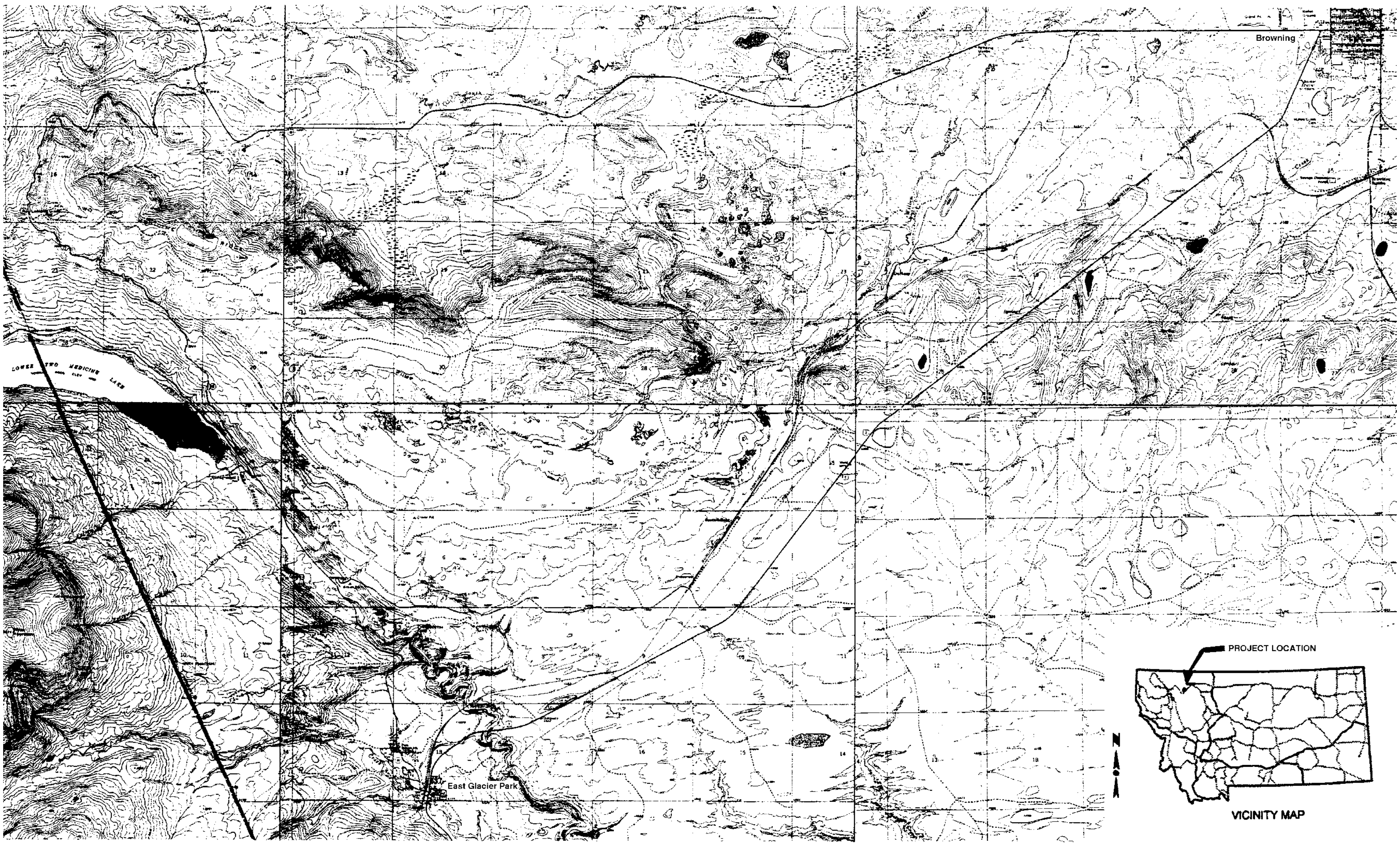
<u>Browning</u>

The 2000 Census estimated the population of the Blackfeet Indian Reservation to be 10,100; of this 8,507 are American Indian/Alaskan Native. Enrollment information was also obtained from the Blackfeet Tribe. The total number of enrolled members living on the Blackfeet Indian Reservation is 8,326 as of April 5, 2001. Also, there are 4,215 descendants living on the Blackfeet Indian Reservation. From the 2000 Census data, there are 1,394 people of different races living on the Reservation. The total population of the Blackfeet Reservation based on the Blackfeet Tribe's enrollment and descendent data and the 2000 Census data is 13,935. It is estimated that 55% of the population on the Blackfeet Indian Reservation or 7,665 people live in Browning. For comparison, the Town of Browning currently has 1,926 commercial/residential water service connections and it is estimated that there are 4 people per service connection. Based on these numbers, there are 7,704 people living in Browning and the surrounding housing projects today. Based on current area trends, the population in Browning is expected to grow at a rate of 2.0% per year over the next 20 years. By the year 2010, it is estimated that the population of Browning will reach approximately 9,390 and 11,500 by the year 2020 based on the above growth rate.

The original water system for the Town of Browning was constructed in the mid 1950's. Currently, the Town's water system just barely meets the peak water demands of the community. The peak water demand for Browning is 1,625,000 gpd. The current water supply utilized by the Town of Browning currently produces 1,150 gpm. If the system is pumped continuously, 1,656,000 gpd of water can be supplied to the community. But this does not allow for pump down time and fire flow protection for the community cannot be met with the current system. The current system also does not allow for any growth in the community. Several times a year the residents of Browning must go without water for a day or two because the wells are not able to keep up with the demand of the community during high peak use. Therefore, the quantity of water supplied to the town needs to be increased to meet peak use, allow for fire flow and to allow for growth. Browning's distribution system is in fair to good condition. The Town of Browning is in the process of replacing some of the older water mains. The water mains have accumulated quite a bit of sediment and iron and manganese precipitate over the years, which needs to be thoroughly flushed out of the distribution system.

Browning charges various rates based on the type and size of service connection and has recently added an additional monthly fee of $5.00 to each user. The revenue generated from this additionally fee will be used to repair or replace the older water mains in the distribution system. In 1998-1999

Figure 1. Project Area - Blackfeet Community Water Project.



Browning generated $336,109.81 in revenue from their water system. Browning's water operating expenses were $275,889.36, and had a net operating income of $60,220.45. The town currently has an existing loan of $126,000 borrowed from the State Intercap Loan Fund.

The Browning water supply has been historically inadequate in terms of quality and quantity to serve the community. This has been well documented. Water shortages have occurred several times in prior years. Browning currently relies on ground water as the source for its drinking water supply. The water supplied to the community has been tested over the years. It has been shown to not pose any health risks and the water currently meets EPA's Primary Drinking Water Standards. However, the water taken from the Flatiron Spring site has been found to contain high levels of iron and manganese. These two constituents have not been found to cause health problems, but they are cause for concern. Iron and manganese are precipitated out of the water when chlorine is introduced. This causes a build up of iron and manganese on the bottom of the pipes. When the system is flushed or breaks in the pipes occur, these sediments in the pipe are stirred up. The water users are then supplied water that is not aesthetically pleasing to drink because it is dark and cloudy. This situation also causes a high chlorine demand, which reduces chlorine residuals downstream. To maintain the proper chlorine residuals downstream more chlorine would need to be added thus raising the chlorine costs per year.

The major concern of the community is the lack of water. The town's water supply has not been able to keep up with the demands of the growing community. Water shortages are a major concern especially for households with elders or young children. Browning typically experiences high water use in the summer and winter months. During the summer, lawns are watered and water consumption increases. Water shortages during the hot summer months can be a health risk, especially to the elders in the community. Water helps to cool down the body when it is extremely hot. If there is not enough water to drink, some residents may become dehydrated. During the winter months, water use is also high. Many households leave their water running to prevent their pipes from freezing during the cold winter months. Water shortages during the winter can be a serious problem. If the residents cannot make it to the store for water, they must make do with what they have in the house, which may not be sufficient.

Many reports have been written about Browning's water supply problems. The Indian Health Service, Blackfeet Housing and the Blackfeet Tribe have assisted on many projects to increase the quantity of water supplied to Browning. In July of 1994, the Engineering Consulting firm Thomas, Dean & Hoskins, Inc. prepared a report for the Blackfeet Housing Authority. In the report they state, "The water supply for the Browning area has historically been inadequate to meet peak demand." In 1997 the US Geological Survey prepared a report on the Water Resources of the Browning/Starr School Area, Blackfeet Indian Reservation. This report also mentioned the problems Browning has had over the years trying to meet the water demands of the community.

The Town of Browning tried to alleviate this water shortage concern by renovating the Flatiron Springs well and infiltration gallery. The infiltration gallery was abandoned and in its place four wells were drilled. These renovations were completed and placed online in the Fall of 1999. The production of these four wells was originally estimated to produce 1,000 gpm. But after the wells were put on line, they were found to produce only 750 gpm. However this is still the largest supply source for Browning. The water produced from these wells was also found to be high in iron and manganese. This project helped Browning to just barely meet the peak water needs of the community but was still not adequate to provide for fire protection and allow for the rapid growth of the community. The high levels of iron and manganese were also a major concern for the community. The residents of Browning were still being supplied dirty water when these two metals precipitate out of solution after chlorine is added.

Browning's water distribution system is maintenance intensive. The town currently utilizes approximately

17 wells to supply water to the community. Each of these wells needs to be maintained, which increases the costs of operating the system. Some of the existing pipes in the distribution system were installed in the 1950's. Browning is currently in the process of replacing these old water mains. The water main breaks Browning has experienced over the past few years usually occur in these older sections of pipe. Most of the old asbestos-cement pipes have been replaced, but there are still a few in use. The two elevated tanks located in Browning have rusted and are full of holes and are no longer in use. There are three storage tanks currently in use. A one million-gallon storage tank located on the Southwest side of Browning is in good condition. The 250,000-gallon storage tank at the Parson's site has been recently repaired and repainted. The 300,000-gallon storage tank at the Industrial Site is currently being repaired and repainted.

The town has been in the process of repairing the current water distribution system for some time. They have begun a program to flush the existing water mains to remove the sediment build-up within the system. Browning has repaired several water main breaks in recent years. Most of the distribution system is comprised of PVC pipe. However, some of the distribution system is comprised of old cast iron and AC pipe that have deteriorated over time. Leaks are a concern for this system in the portions composed of the cast iron and AC pipe. The Town has recently completed a leak detection survey to identify the severity of the problem. However, the survey indicated minimal findings, with no major leaks detected. The Town of Browning has repaired a storage tank four miles west of town at the Parson's site and will be repairing a leaking water tank one mile south of town.

Browning has a large potential for growth if an adequate supply of water can be supplied to the community. Between 1990 and 1997, Browning has grown at a rate of 5.4% per year and between 1997-2000 at a rate of 2.0%. Based on current trends, it is estimated that Browning will continue to grow at a rate of 2.0% per year. Blackfeet Housing has had to put construction of new housing projects on hold because there is not enough water to supply these new homes. The community desperately needs to build new housing for this growing community. Blackfeet Housing currently has a waiting list for 1000 new homes, but these homes cannot be built until the water situation is resolved. The Town of Browning has put a hold on new housing construction projects due to the inadequate water supply.

The Town of Browning has difficulty meeting the water demands of the community. The total amount of water required to meet peak demands for domestic use is 1,625,000 gpd. The current system is capable of producing 1,150 gpm or 1,656,000 gpd. This rate is achieved by pumping 24 hours per day. Therefore, during times of peak demand, any interruption in the system has the potential to cause a water shortage. Under normal circumstances storage can handle these interruptions, but only for a short period of time. Browning is in the process of improving the distribution system, which will stop most of the water loss. But even after the improvements to the system are completed, the water source will not be able to produce enough water for this rapidly growing community.

Browning currently has an estimated population of 7,704. The peak flow for the community is 1,625,000 gpd or 211 gpcd, which is considerably lower than the peak use per capita of other communities across the country. For comparison, Cut Bank has an average water use of 215 gpcd and a peak water use of approximately 400 gpcd. One reason for the low per capita water use is the lack of commercial businesses in Browning. Another reason for the low per capita use is the lack of an active flushing program due to the lack of water. However, once an adequate source of water is supplied to Browning, the per capita use is expected to increase. Typically the average water use is between 150-220 gpcd and the peak water use is between 300-440 gpcd. Since the residents of Browning have shown conservative water use and there are only a few commercial businesses, the lower range of the average use will be applied to Browning. Based on these numbers, Browning would require 1.16 mgd for average use and 2.31 mgd for peak use. As stated above, the maximum amount of water that can be supplied to Browning is 1,656,000 gpd, if the supply wells are pumped 24 hours/day. The amount of water is still not adequate to provide fire protection or allow for growth of the community.

Based on the population trends discussed previously, it has been estimated that Browning's population will increase to 11,500 by the year 2020. A treatment plant to serve Browning will be designed taking into consideration the 2010 and 2020 water use projections. Table 1 illustrates these projections. The plant will have an initial treatment capacity of 2.82 mgd or 1,960 gpm and will have expansion capabilities to 3.45 mgd or 2,400 gpm.

Table 1.
Projected Water Demand For Browning

Year	Population	Peak Day (mgd)	Peak Day (gpm)	Average Day (mgd)
2000	7,704	2.31*	1,604	1.16*
2010	9,930	2.82*	1,960	1.41*
2020	11,500	3.45*	2,400	1.73*

* Based on average use of 150 gpcd and peak use of 300 gpcd.

EAST GLACIER

East Glacier is a resort community with approximately 400 year round residents, based on Census 2000 data. Of the 400 year round residents, 205 are American Indian/Alaskan Native. During the summer tourist season the transient population may exceed 1100 people. Blackfeet Housing has long-term projections to build 100 new homes that will house approximately 400 more residents. This brings the design year population to about 800 residents.

It is also anticipated that the new treatment plant would serve Glacier Park Inc. (GPI) which would be a large consumer of treated water. GPI typically sees between 30,000 to 35,000 visitors through the months of June, July, August and September. The amount of water required to serve GPI is given below, Table 2.

The water used to supply East Glacier is currently taken from Midvale Creek above a diversion dam approximately one mile west of town. A 12 to 14-inch raw water main, which is owned by Glacier Park Inc. (GPI), currently serves both East Glacier and GPI. Chlorination is the only means of treating the surface water supplied to the East Glacier Water and Sewer District users. Glacier Park Inc. built a pressure clarification and filtration system to serve GPI facilities in 1986, which has a rated capacity of 150 gpm. The system operates well most of the year except when the raw water turbidity levels are extremely high.

In 1980, East Glacier built an infiltration well and pump house three miles southwest of town along Railroad Creek just off the Blackfeet Reservation. The anticipated capacity of this well was 180 to 200 gpm. Also included in this system were a 100,000-gallon storage tank and a transmission main to East

Glacier. The system was completed and placed on line in 1982. This tank can be put on-line with the turn of a valve to supply additional fire flow to the community. Unfortunately this system was abandoned within a year because the actual production of the infiltration well was only 110 gpm with constant pumping and high levels of iron were detected.

East Glacier's intake facilities are in poor condition. The diversion structure at the Midvale Creek reservoir is in need of repair. The existing sluice gate needs to be replaced and a new intake pipe and screen are needed. Sediment accumulates at the diversion dam and must be removed with a backhoe once or twice per year. This causes the water to become very turbid and since there is no method of treatment, the residents of East Glacier are supplied water that does not meet the requirements of the Safe Drinking Water Act. Because of this East Glacier has been issued a Boil Water Order. The raw water main is composed of 500 feet of 14-inch woodstave pipe, 1400 feet of 14-inch asbestos cement pipe and 6100 feet of 12-inch PVC pipe.

East Glacier's distribution system is thought to be in good condition. The distribution system west of Highway 2 was constructed in 1980-81 of PVC C-900 pipe and will last indefinitely. The distribution system east of US Highway 2 is constructed of cast iron and asbestos cement pipes and is also thought to be in good condition, however most of the breaks and problems occur here.

The East Glacier Water and Sewer District currently has an outstanding balance on a loan borrowed from USDA Rural Development Administration. This loan was taken out in 1982 to pay for water improvements. East Glacier currently has a balance of $778,273.30 with 22 years remaining on a 40-year note at 4.5% interest as of March 22, 2001. Steps are currently in place to resolve this debt with RDA. The Blackfeet Tribe has tentatively agreed to take over operation of the East Glacier Water & Sewer District (EGWSD). If the Tribe takes over the operation of this system, they will also assume the existing debt of the District. However, this debt will be written down to a present day value. Negotiations are underway to determine the exact amount the debt will be written down to. The Blackfeet Tribe will then have 22 years to pay off this debt.

The water supplied to East Glacier is in direct violation of the Surface Water Treatment Rule of the Safe Drinking Water Act Amendments. A Notice of Violation was sent to the East Glacier Water and Sewer District on August 9, 1993. The District has been on a Boil Water Order since then. The residents of East Glacier may be exposed to health risks due to bacteria contamination, Giardia and other water-borne contaminants that may be present in the water supply. The Blackfeet Community Hospital has treated 48 patients for Giardia/Giardiasis since 1990. These cases are both presumptive and confirmed. The exact cause or source of these cases could not be determined; however having an untreated surface water source in the area is definitely a cause for concern. On September 28, 1998 a Microscopic Particulate Analysis was performed on water taken directly from Midvale Creek. The result of the MPA indicated that Giardia was present in the water. The turbidity levels of the water supplied to the community have exceeded the 1.0 NTU MCL set by the Surface Water Treatment Rule on several occasions.

The existing water facilities do not permit the East Glacier Water and Sewer District to supply the community with water that meets the criteria set forth in the Safe Drinking Water Act. The construction of a water treatment plant will provide safe drinking water to the residents and businesses of East Glacier.

There is potential for residential and commercial growth if safe drinking water can be supplied to East Glacier. The Blackfeet Housing has plans to build 100 new homes over the next few years. However, GPI currently has no plans for expansion. East Glacier will only be able to grow if safe drinking water is supplied to the community

Water use data for East Glacier was obtained from a report prepared by MSE-HKM Engineering for the Blackfeet Nation on April 8, 1999. Water use data was gathered from 1994-1998 and is broken down between East Glacier and Glacier Park Inc. Water use was averaged over the 5 years of data available to determine the water use per year. From this data it was determined that on average East Glacier uses 36,000,000 gallons per year and GPI uses 13,400,000 gallons per year with a total use of 49,400,000 gallons per year or 94 gpm. However the Montana Department of Environmental Quality (DEQ) requires that water treatment facilities be designed for maximum day demand and the design year. The peak month for East Glacier was July 1994 at 6,548,759 gallons, with an average day use of 211,250 gpd. *The Design of Small Water Systems* by Joseph A. Salvato, P.E. recommends a peaking factor of 1.5 to convert the average day of the peak month to the peak day demand. Therefore the peak day demand for East Glacier is 316,875 gpd or 220 gpm. The peak month for GPI was August of 1994 at 3,891,800 gallons with an average day use of 125,540 gpd. The peak day demand for GPI is 188,310 gpd or 130 gpm. The present demand of East Glacier and GPI would be 505,185 gpd or 350 gpm. The water use projections for 2010 and 2020 are based on a peak use of 300 gpcd and also an increase to account for commercial growth.

East Glacier's population fluctuates seasonally because it is a summer resort community and therefore per capita water use would not be used as the design criteria. The water use projections for East Glacier and GPI are given below in Table 2, which reflects that there is no future growth anticipated for GPI. The lodge in East Glacier, owned by GPI, operates at maximum capacity during most of the summer tourist season. There are no plans to expand the capacity of the lodge. Therefore, the water use should remain constant over the next 20 years.

Table 2.
Projected Water Demand For East Glacier & GPI

Year	Population	Peak Day (gpd)				Total Peak Day Demand	
		East Glacier		GPI		East Glacier & GPI	
		gpd	gpm	gpd	gpm	gpd	gpm
2000	400	316,875	220	188,310	130	505,185	350
2010	800	436,875	300	188,310	130	625,185	430
2020	900	466,875	325	188,310	130	625,185	455

<u>BROWNING AND EAST GLACIER</u>
Table 3 shows the projected water use for Browning and East Glacier. These would be the design flows based on peak day use if a regional water system were selected as the preferred alternative. The total amount of water required to meet the current peak water demands of Browning and East Glacier is approximately 2,815,185 gpd or 1,950 gpm. However, as stated above, Blackfeet Housing has an immediate need to build 1,000 new homes. If there were 4 people per home that would add an additional 4,000 people to the system. Because of the growth that is anticipated over the next few years

the plant will be designed based on year 2010 water use estimates. The plant capacity will be 3.445 mgd with expansion capabilities to 4.105 mgd. Additional treatment capacity shall be added as needed based on the water demands of the communities.

Table 3.
Projected Water Demand For Browning, East Glacier & GPI

Year	Browning	East Glacier	GPI	Total (gpd)	Total (gpm)
2000	2,310,000	316,875	188,310	2,815,185	1,950
2010	2,820,000	436,875	188,310	3,445,185	2,400
2020	3,450,000	466,875	188,310	4,105,185	2,850

PREFERRED ALTERNATIVE

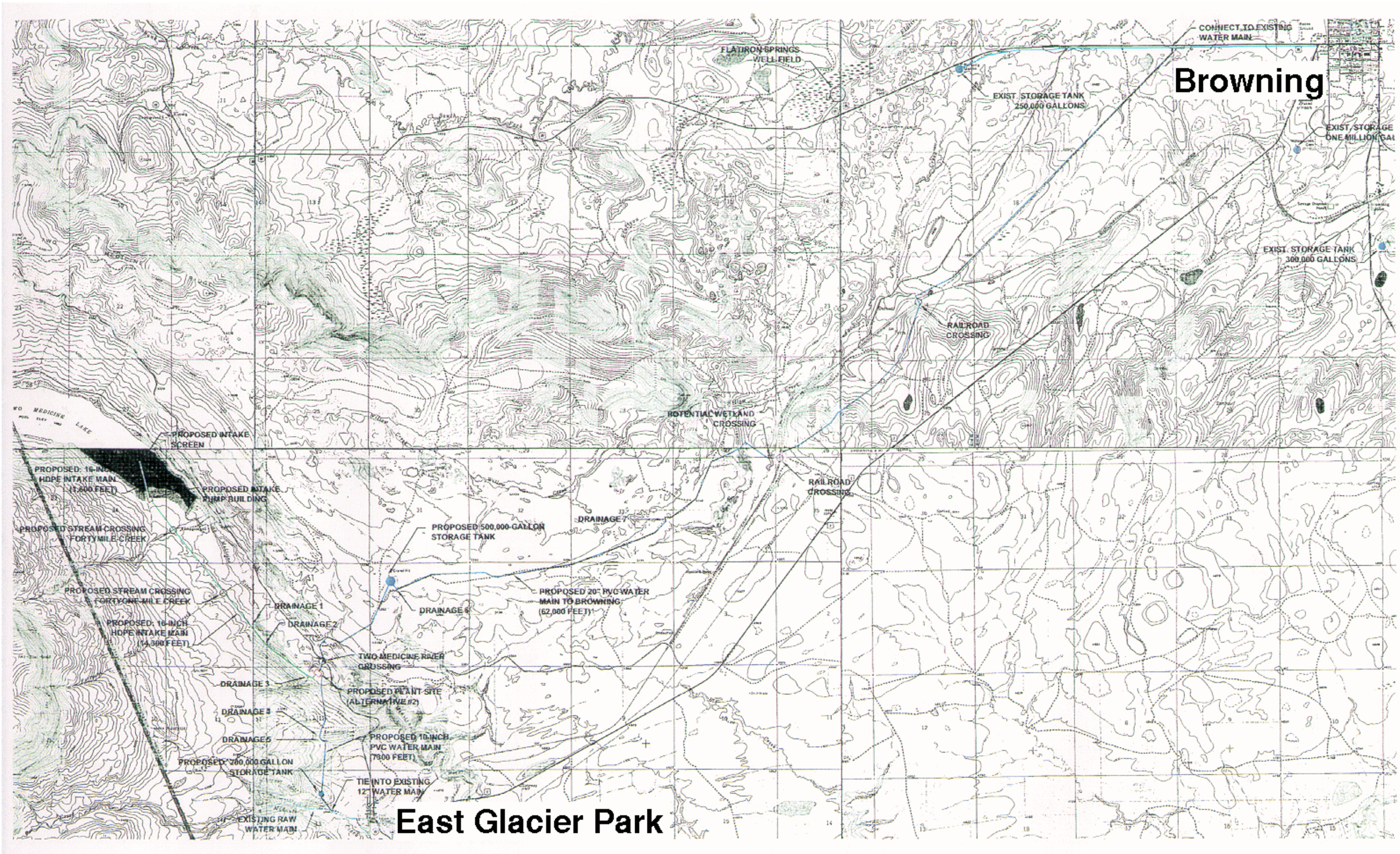
The preferred alternative, Figure 2, will utilize water from Lower Two Medicine Reservoir to serve both East Glacier and Browning from one treatment plant. The reservoir is fed by the Two Medicine drainage, which is comprised of mountain springs and perennial snowmelt, which feeds Upper Two Medicine Lake. Upper Two Medicine Lake is the water source for Two Medicine Lake, along with mountain streams and perennial snowmelt. The water from Two Medicine Lake then flows into Lower Two Medicine Reservoir.

The Bureau of Indian Affairs constructed the Lower Two Medicine Dam and Reservoir for irrigation purposes. It was decided to utilize the reservoir for drinking water because of the large amount of storage that is available. The reservoir has a total capacity of 25,120 acre-feet and an active capacity of 19,760 acre-feet. The active capacity of the reservoir represents the water available for irrigation. This leaves 5,360 acre-feet or 1.75 billion gallons of inactive capacity. The inactive portion or dead pool of the reservoir consists of the original lakebed, which is the portion that is not controlled by the dam. The intake structure for the treatment plant will make use of this inactive portion of the reservoir. The treatment plant will initially be sized to treat a peak flow of 2,400 gpm or 3.48 mgd with a future capacity of 3,000 gpm or 4.32 mgd. The estimated average production of the treatment plant in 2020 will be approximately 2.33 mgd or 2,611 acre-feet per year.

The top of the dead pool has an elevation of 4,861 feet. The top of the intake screen will be at an elevation of 4,855 feet. In the worst-case scenario, six feet of water above the screen in the dead pool will be available to supply water to the plant. To be conservative we will assume that three feet of water may be lost to evaporation or freezing. Therefore, three feet of water above the screen or 84.61 million gallons of water will be available to supply the plant with raw water. This condition would only be encountered in the most severe drought year. If the treatment plant produces an average of 2.33 mgd, and assuming no inflow or outflow, it would take 36 days to consume the 84.61 million gallons of water. However, for Lower Two Medicine Reservoir to receive no inflow, both the Upper Two Medicine and Two Medicine Lakes would have to dry up first. There are mountain springs and perennial snowmelt that will supply water to the lakes and reservoir year round.

The lowest monthly mean was November 1998, with a mean flow of 19.1 cfs. The historical lowest annual 7-day minimum was 13 cfs. On average, Lower Two Medicine Reservoir receives 244,800

Figure 2. Preferred Alternative.



acre-feet. The amount of water available is more than adequate to supply East Glacier and Browning with treated water and still leave enough for irrigation since the water will be drawn from the inactive portion of the reservoir. Irrigation is typically done from May to September of each year, and these are the months with the highest stream flows and available runoff. This source was selected for its location, water quality and quantity, which is more than adequate for the proposed project.

An advantage in using the Lower Two Medicine Reservoir is that the water turbidity levels in the reservoir remain relatively constant. Large fluctuations in turbidity are not as drastic in the reservoir as those seen in Midvale Creek or Cut Bank Creek. The reservoir acts as a settling basin that helps control the turbidity spikes seen in streams and rivers during spring run-off. Turbidity spikes greater than 2,000 ntu's have been observed in both Midvale Creek and Cut Bank Creek. These large fluctuations in turbidity can cause difficulties when treating the water. A water quality analysis was done on Midvale Creek and Two Medicine Reservoir in February. This source has the ability to be utilized as a regional treatment plant to serve both East Glacier and Browning. There is adequate Tribal land and water available to construct a large treatment facility that could serve these two communities.

<u>Intake Facility</u>

The intake will draw water directly from Lower Two Medicine Reservoir, by placing an intake screen in the inactive portion of the Reservoir, Figure 3. The intake will be a USF Johnson Intake Screen. The preliminary design is for one tee-shaped intake screen having 0.07-inch slot openings and an open area of 50%. The intake screen will have a diameter of 27 inches with a capacity of 3,200 gpm. The velocity of the water entering the screen will be 0.5 ft/second. At this low velocity aquatic life will not be pulled into the intake or be trapped on the screens surface. The intake screen will be fitted with an air backwash system to allow for hands free cleaning of the screen.

The intake structure will accommodate submersible pumps that will supply the raw water to the treatment plant, Figures 4 and 5. The future design of the water treatment plant is 3,000 gpm. However, the intake pumps will be designed to supply 2,400 gpm to the treatment plant. Design of the intake calls for four (4), 50-HP pumps with a capacity of 750 gpm each. The total production from the intake will be 3,000 gpm. This will also enable the system to have some redundancy built in. If one pump is out, the intake will be able to supply 2,250 gpm to the treatment plant. These are preliminary designs and are subject to change once the final design is complete.

<u>Water Treatment Plant</u>

The selected site is located approximately 2 miles southeast of the Lower Two Medicine Dam. See Figure 3 for site location and proposed pipeline routes. The treatment plant will be located on Tribal land. The plant will be approximately a ¼ mile off of Highway 49. An access road will need to be constructed, but this location will allow for easy access throughout the year. The Blackfeet Tribe will need to make the treatment plant access road a priority and it could be done by the BIA Road Department. Another advantage to this site is that the Two Medicine River will only be crossed once with the supply line to Browning, which will lower the capital costs for construction.

Microfiltration uses a hollow fiber membrane to remove particles greater than 0.1 to 0.2 microns, depending on the membrane manufacturer, from the raw water feed stream. The goal of this treatment plant is to meet the water quality standards set forth by the Surface Water Treatment Rule of the Safe Drinking Water Act Amendments. Feed water, under pressure, flows from the outside of the membrane to the inside or inside to the outside, depending on the manufacturer. Only particles with diameters smaller than 0.1 to 0.2 microns can pass through the membrane. Giardia and Cryptosporidium typically have diameters between 5 and 14 microns, and therefore will not be allowed to pass through the

Figure 3. Intake and Water Treatment Plant Location.

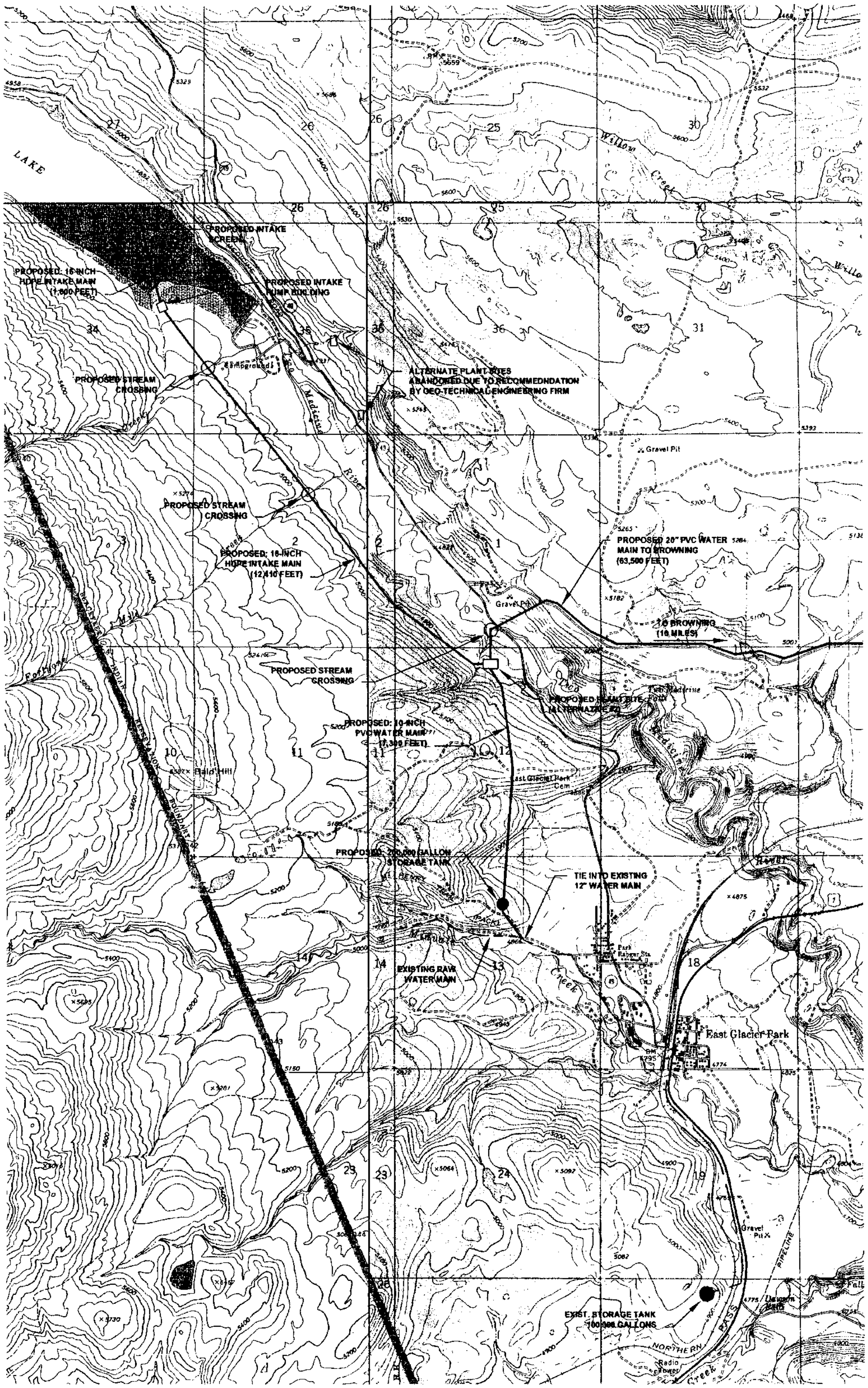


Figure 4. Intake Plan and Profile.

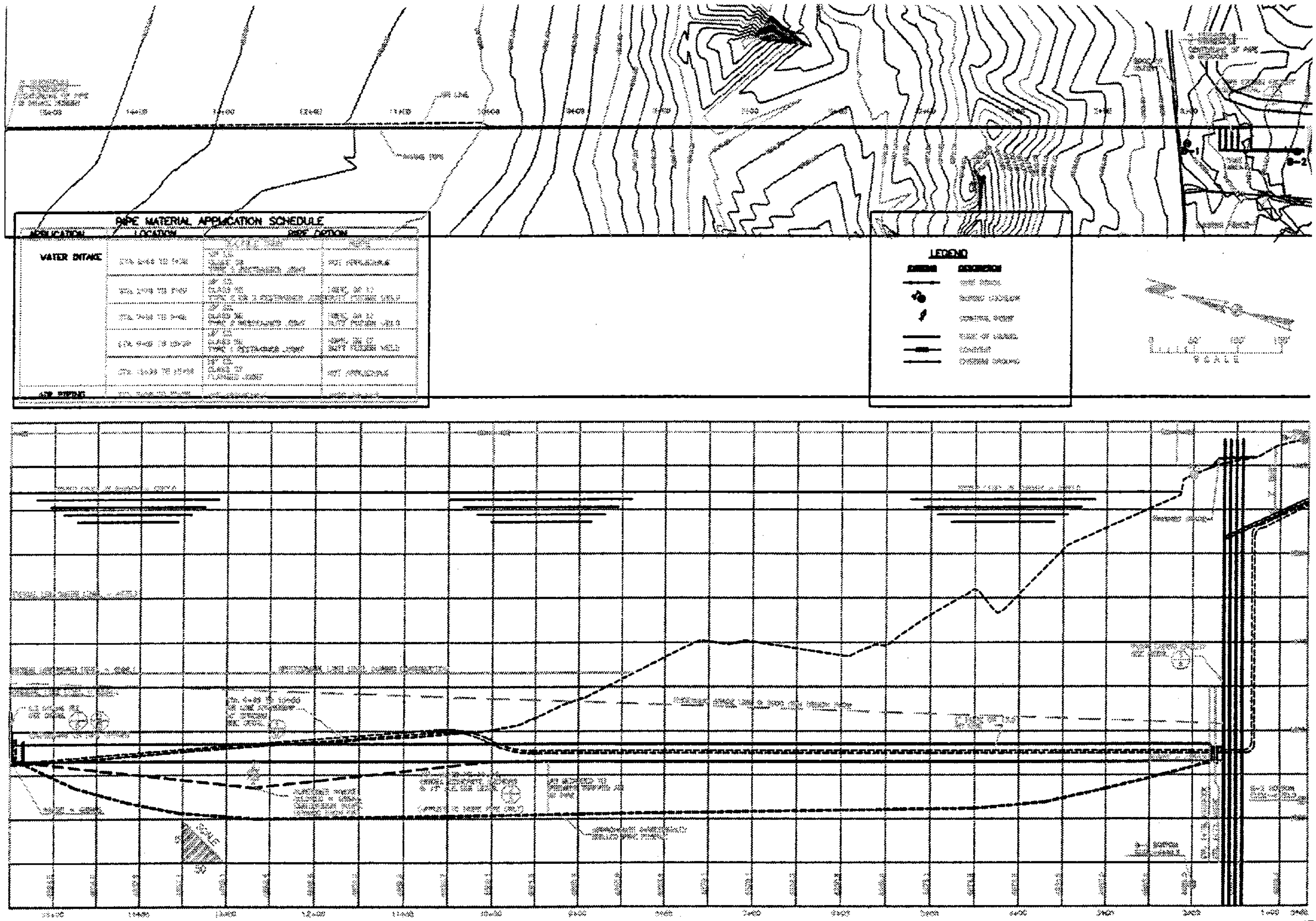
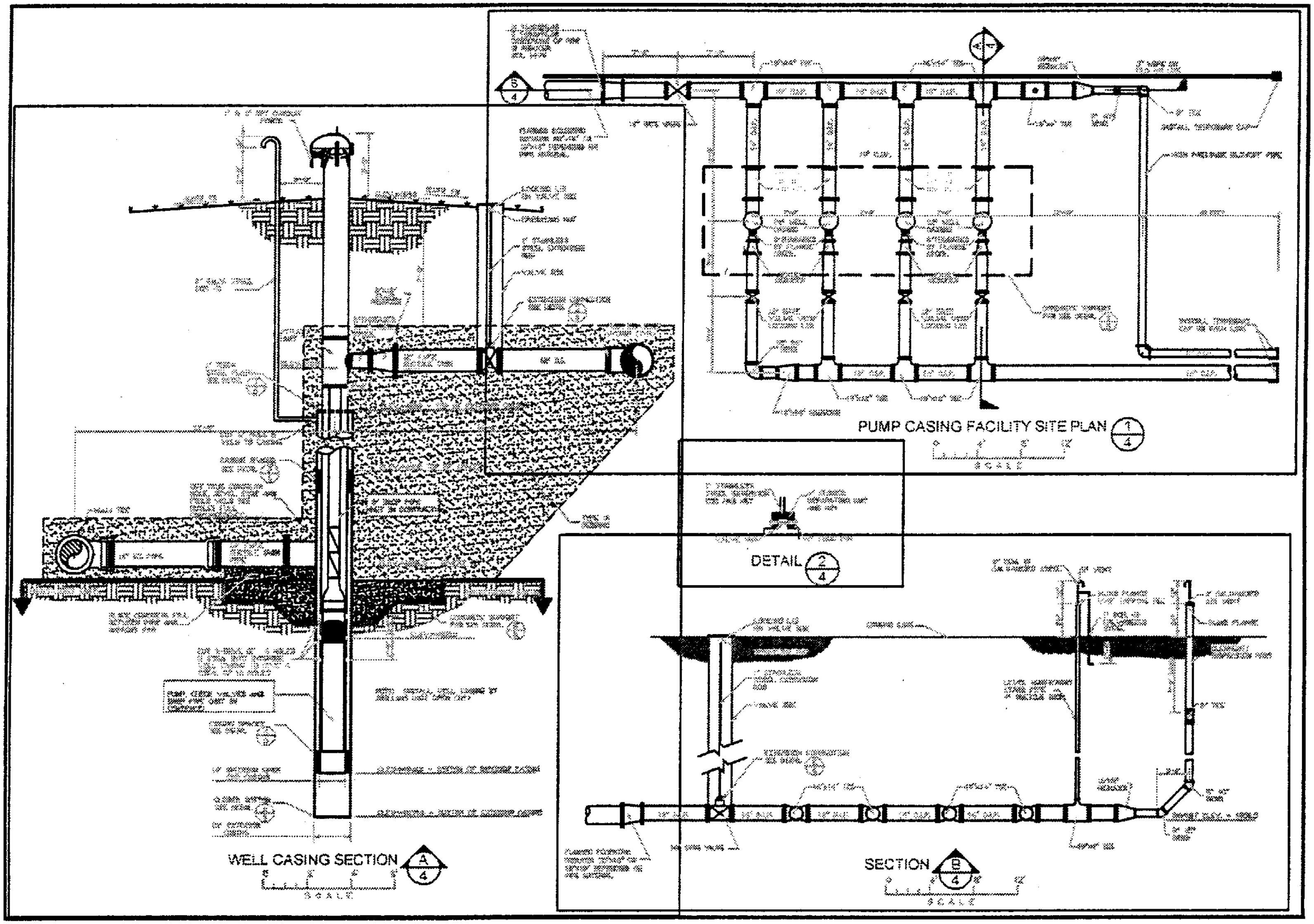


Figure 5. Raw Water Pump Sation.



membrane. Microfiltration provides an absolute barrier to Giardia and Cryptosporidium. The particles that do not pass through are deposited on the surface of the membrane. As the deposits on the membrane build up, the resistance to flow through the membrane increases. Once the resistance, measured as transmembrane pressure, reaches a pre-defined value the system performs a backwash to remove the deposits from the membrane. There is no addition of chemicals to aid in the filtration process, and therefore, no chemicals are present in the backwash water. A discharge permit will be required to discharge the backwash water into the river. Since no chemicals are used in treating the water, the discharge requirements are not as stringent. After a period of time, the transmembrane pressure cannot be restored by backwashing. At this point the filters need to be chemically cleaned. A clean-in-place (CIP) is then initiated. A chemical solution typically caustic soda, citric acid or both, is circulated through the filters. The chemical waste can either be stored in a detention pond or neutralized and discharged into the water source. The microfiltration treatment plant can be operated automatically or in manual mode. Microfiltration water treatment plants can be monitored and controlled from a remote computer. Because of this, a certified operator's presence at the treatment plant is not required at all times.

A 2,400 gpm microfiltration treatment plant will be required to serve as a regional plant to provide Browning, East Glacier and GPI with treated water. The cost of the microfiltration treatment equipment sized to treat 2,400 gpm is $1,500,000 for equipment and $352,000 for the building, with $160,000-$170,000 annual O&M costs. These estimates were based on extensive research of microfiltration water treatment plants that have been installed throughout the United States. Detailed costs, which include everything required to construct and operate the plant are shown in Table 4.

A building size of 3,200 square feet is required to house the microfiltration equipment to produce 2,400 gpm with future expansion capabilities. A metal, open bay style building will be constructed and will include an office, lavatory, equipment storage, laboratory, chemical storage and a chlorine dosing room. The building sizes are based on a US Filter/Memcor microfiltration water treatment plant. However, the manufacturer has not been selected at this time. The building costs are based on $110.00/ft^2 This cost also includes the construction of a clearwell located below the treatment plant building. Schematics of the microfiltration process and building layout are given in Figures 6 & 7.

Operating costs data were determined from a pilot study conducted by IHS. Operation and maintenance data from several microfiltration water treatment plants currently in operation was also reviewed. These costs includes amortized membrane replacement costs, power and chemical costs, replacement parts cost, labor costs and a reserve fund to save for the cost of future plant expansion.

<u>Clearwell</u>
The clearwell will be designed to provide for a small amount of finished water storage at the plant and for the addition of chlorine for disinfection. To provide the required contact time with a residual of 1.0 mg/L at a flow rate of 3,000 gpm a 210,000-gallon clearwell would be required. However, the clearwell will have a design volume of 100,000 gallons that will provide 47.6% of the required contact time. The additional contact time will be achieved in the 500,000-gallon storage tank and the pipelines supplying both Browning and East Glacier. The water level in the clearwell would also control when the treatment plant starts up and stops.

<u>Storage Facilities</u>
Browning currently utilizes three storage tanks. A one million-gallon storage tank is located approximately a ½-mile southwest of town. A 250,000-gallon storage tank is approximately three miles

Table 4. Microfiltration Plant Cost Estimate.

2400 GPM Microfiltration Plant

Microfiltration Equipment Cost	$	1,400,000.00	
Process Piping:	$	48,000.00	
Shipping:	$	3,750.00	
Building Size:		3200	sq. ft (33.3'x90')
Building Cost:	$	352,000.00	(@ $110.00/ft^2)
Total Capital Cost	**$**	**1,803,750.00**	
Total Number of Modules:		540	
Replacements During Project Life:		2	
Cost per Module:	$	650.00	(Year 6)
Cost per Module:	$	650.00	(Year 13)
Replacement #1 Cost:	$	351,000.00	(Year 6)
Replacement #2 Cost:	$	351,000.00	(Year 13)
Present Worth Replacement #1:	$	247,455.00	(Year 6, 6% Interest)
Present Worth Replacement #2:	$	164,548.80	(Year 13, 6% Interest)
Total Amortized Membrane Cost:	**$**	**21,836.20**	
Total Annual Power Costs:	**$**	**42,834.29**	
Total Annual Chemical Costs:	**$**	**10,312.05**	
Total Annual Parts Budget:	**$**	**20,000.00**	
Total Annual O & M Cost (No Labor)	**$**	**94,982.54**	
Total Labor Costs:			
Certified Plant Operators (2):	$	70,000.00	
Total Annual Labor Costs:	**$**	**70,000.00**	
Total Annual O & M Cost (With Labor):	**$**	**164,982.54**	
Capital Cost:	$	1,803,750.00	
Membrane Present Worth:	$	412,003.80	
Annual Cost w/o Amortized Costs:	$	143,146.34	
Total Present Worth:	**$**	**4,345,413.44**	

Figure 6. Microfiltration Water Treatment Plant Process Schematic.

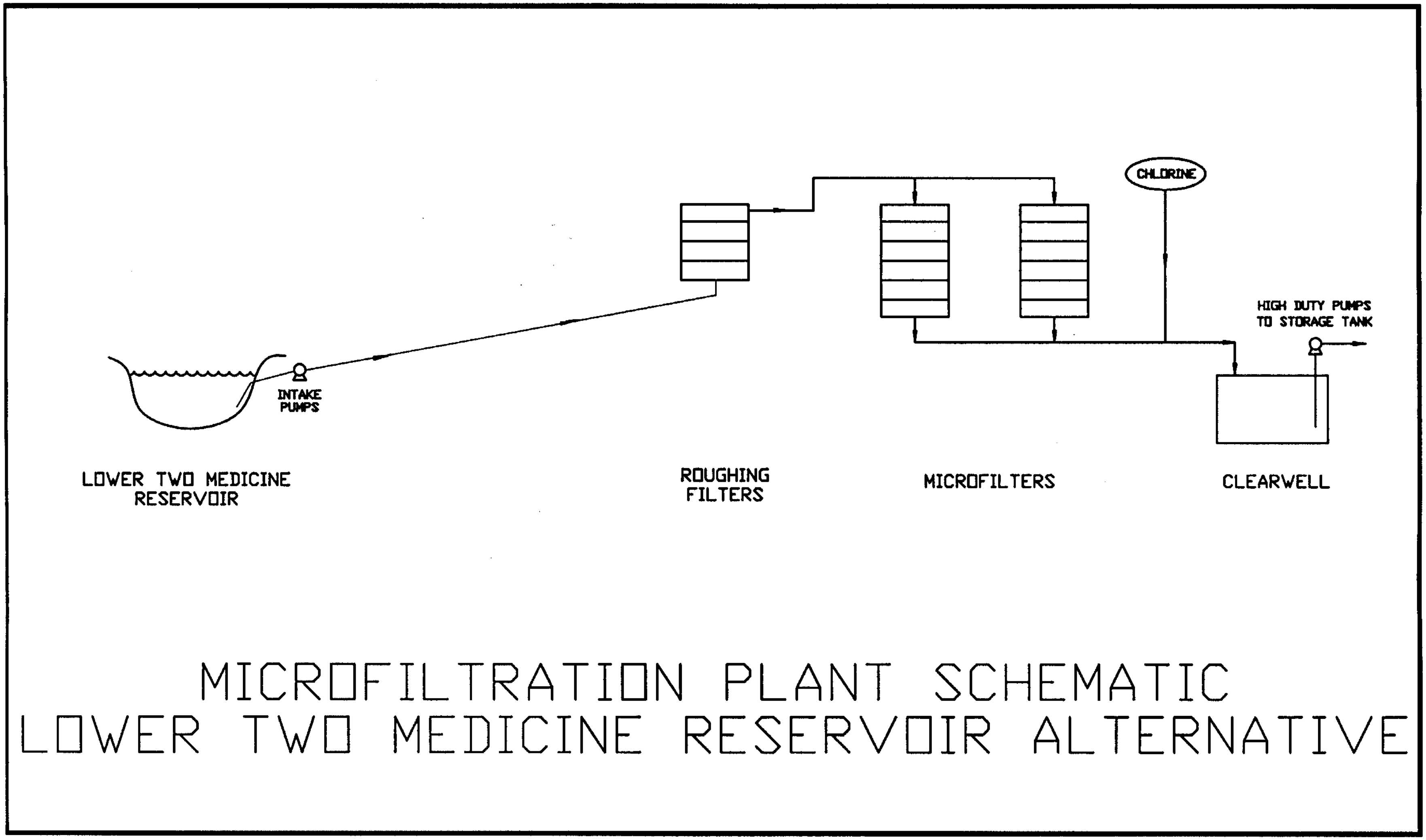
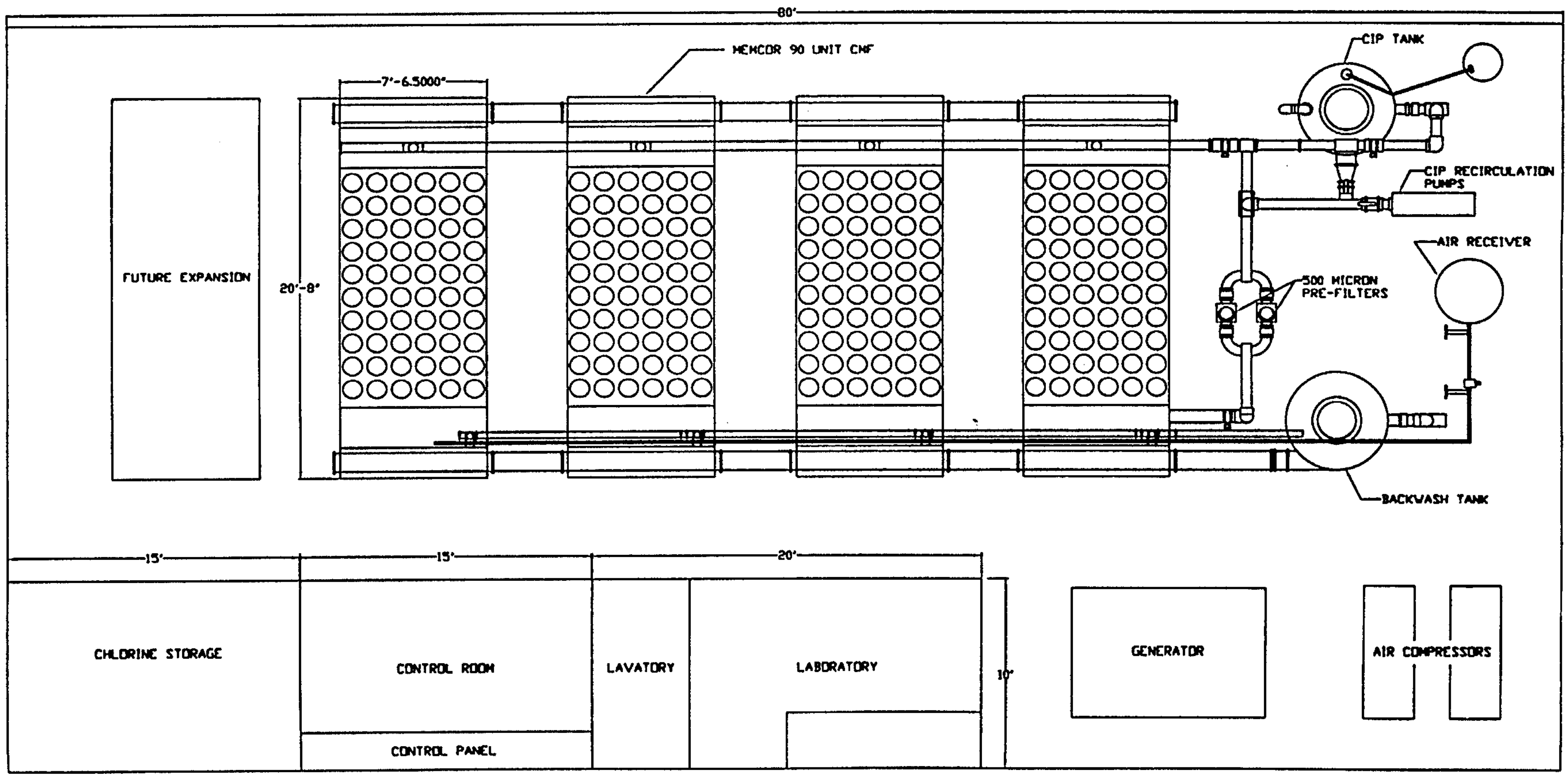


Figure 7. Microfiltration Water Treatment Plant Layout.



Project Description (Cont.)

west of town at a site known as Parson's. The third tank is located about one-mile south of town and stores 300,00 gallons.

East Glacier currently has a 100,000-gallon storage tank located about one mile south of town. This tank is currently off-line, because the only way to fill it is from the treatment plant and pumping facilities owned and operated by Glacier Park Inc. It will be utilized once the treatment plant is constructed.

Additional storage will be available from the 100,000-gallon clearwell, the proposed 200,000-gallon storage tank serving East Glacier and in the water mains supplying water to Browning and East Glacier. The volume of water stored in the 20-inch PVC main to Browning is 1,036,000 gallons. The volume of water stored in the 10-inch PVC main serving East Glacier is 30,000 gallons.

<u>Pumping Stations</u>:
Design of the pumps required to supply East Glacier with treated water proposes three (3), 20-HP pumps, each with a capacity of 250 gpm and the design of the pumps required to supply Browning with treated water also proposes three (3), 125-HP pumps, each with a capacity of 1,250 gpm. These designs allows for one pump to be out of service and still provide East Glacier and Browning with a sufficient amount of water. These are preliminary designs and are subject to change once the final design is complete.

<u>Distribution</u>:
The transmission pipelines will be owned and operated by the Blackfeet Tribe. A 20-inch HDPE intake main three miles in length will supply raw water to the treatment plant. From the treatment plant, water will be pumped through a 16-inch PVC water main 2,640 feet in length to a 500,000-gallon storage tank. A 20-inch PVC water main approximately 11.2 miles in length will supply treated water to Browning and a 12-inch PVC water main 2.4 miles in length will supply East Glacier.

Table 5. Project Cost Estimate.

ITEM DESCRIPTION	QUANTITY	UNIT		UNIT COST		TOTAL COST
Phase 1: Intake, Treatment Plant, Main to East Glacier						
1. Soil Borings- Drill Rig with crew	2	DAY	$	1,700.00	$	3,400.00
2. Soil Pits	30	EA	$	200.00	$	6,000.00
3. Tree Removal - Intake Main	12	ACRE	$	5,000.00	$	60,000.00
4. Tree Removal - East Glacier Main	9	ACRE	$	5,000.00	$	45,000.00
5. Rock Excavation	5,000	CY	$	30.00	$	150,000.00
6. Intake Screen	1	LS	$	50,000.00	$	50,000.00
7. 16" Intake Main - Screen to Pump House	1,600	LF	$	400.00	$	640,000.00
8. Intake Pump House	1	LS	$	250,000.00	$	250,000.00
9. Intake Pumps	4	EA	$	15,000.00	$	60,000.00
10. 16" PE Intake Main - Pump House to Plant	12,410	LF	$	52.00	$	645,320.00
11. 16" Gate Valves (Intake)	12	EA	$	4,000.00	$	48,000.00
12. 16" CI, MJ Bends (Intake)	6	EA	$	1,500.00	$	9,000.00
13. Flushing Hydrants	4	EA	$	5,000.00	$	20,000.00
14. Microfiltration Equipment	1	LS	$	1,400,000.00	$	1,400,000.00
15. Install Microfiltration Equipment	1	LS	$	100,000.00	$	100,000.00
16. Treatment Plant Building & Clearwell	3,200	SF	$	110.00	$	352,000.00
17. Back-up Generator	1	LS	$	40,000.00	$	40,000.00
18. Plant Site Grading	7,500	SY	$	2.00	$	15,000.00
19. High Service Pumps - East Glacier	2	EA	$	12,000.00	$	24,000.00
20. High service Pumps - Browning	3	EA	$	20,000.00	$	60,000.00
21. 3-Phase Power to Plant	2,110	LF	$	20.00	$	42,200.00
22. SCADA Controls	1	LS	$	200,000.00	$	200,000.00
23. 10" PVC Main - Plant to East Glacier	7,300	LF	$	48.00	$	350,400.00
24. 10" Gate Valves (East Glacier)	7	EA	$	3,000.00	$	21,000.00
25. 10" CI, MJ Bends (East Glacier)	10	EA	$	1,200.00	$	12,000.00
26. 200,000 Gallon Storage Tank (East Glacier)	1	LS	$	200,000.00	$	200,000.00
Sub-Total Phase 1 Bare Costs					$	**4,803,320.00**
OVERHEAD & PROFIT				15.00%	$	720,498.00
TERO TAX				2.00%	$	96,066.40
ADMINISTRATION FEE				2.00%	$	96,066.40
CONSTRUCTION TAX				3.00%	$	144,099.60
BOND				2.00%	$	96,066.40
ENGINEERING/INSPECTION				5.00%	$	240,166.00
ESTIMATE CONTINGENCY				10.00%	$	480,332.00
Total Cost - Phase 1					$	**6,676,614.80**
Phase 2: Main to Browning						
1. 20" PVC Main - Plant to Browning	63,500	LF	$	60.00	$	3,810,000.00
2. 20" Butterfly Valves (Browning)	50	EA	$	4,000.00	$	200,000.00
3. 20" CI, MJ Bends (Browning)	15	EA	$	1,200.00	$	18,000.00
4. Two Medicine River Crossing	200	LF	$	400.00	$	80,000.00
5. Railroad Boring (2 required)	200	LF	$	100.00	$	20,000.00
6. Road Crossing (2 required)	300	LF	$	100.00	$	30,000.00
Sub-Total Phase 2 Bare Costs					$	**4,158,000.00**
OVERHEAD & PROFIT				15.00%	$	623,700.00
TERO TAX				2.00%	$	83,160.00
ADMINISTRATION FEE				2.00%	$	83,160.00
CONSTRUCTION TAX				3.00%	$	124,740.00
BOND				2.00%	$	83,160.00
ENGINEERING/INSPECTION				5.00%	$	207,900.00
ESTIMATE CONTINGENCY				10.00%	$	415,800.00
Total Cost - Phase 2					$	**5,779,620.00**
Phase 1 Total Cost					$	**6,676,614.80**
Phase 2 Total Cost					$	**5,779,620.00**
Total Project Cost					$	**12,456,234.80**

Project Summary

SUMMARY

The Blackfeet Tribal Business Council has applied to Rural Development for assistance in financing the Blackfeet Community Water Project. The proposed project is to construct a water treatment plant, intake structure, and water distribution system (buried pipeline) to supply both Browning and East Glacier with drinking water utilizing water obtained from the Lower Two Medicine Reservoir, a source that offers an adequate water supply and that provides a significant amount of storage. The goal of the water treatment plant is to meet the present and future water quality standards set forth in the Safe Drinking Water Act Amendments. Water distribution mains will then be constructed to supply water to East Glacier and Browning. The anticipated cost of the project is approximately 13.2 million dollars, as shown in the Project Cost Estimate, Table 5. Rural Development has been asked to provide approximately half of that amount. The Environmental Protection Agency (EPA), Indian Health Service, Blackfeet Housing, Economic Development Administration, and the Treasure State Endowment Program have all committed funding for or applications have been submitted for funding for this project. This project will be owned and operated by the Blackfeet Tribe, and will provide safe drinking water to the residents of East Glacier, as well as to the residents of Browning. Water for East Glacier will be purchased from the Tribe, and it is anticipated that the new treatment plant will also serve Glacier Park Inc., which would be a large consumer of treated water.

The Blackfeet Community Water Project will be constructed in two phases to utilize the funding sources more efficiently. The first phase will include construction of the lake intake pumping system, a raw water intake main, water treatment plant, 200,000-gallon storage tank and water main to East Glacier. The second phase will include the construction of a 500,000-gallon storage tank and water main to Browning. It is planned to begin construction of the intake pumping system by October 2001. In addition to the intake and treatment plant, a pipeline will be installed from the plant to the service areas. These facilities are located on Indian Tribal, Trust, allotted, and fee owned land. The water treatment plant, intake structure and storage tank will be constructed on Blackfeet Tribal Land. The Bureau of Indian Affairs (BIA) and the Indian Health Services (IHS) will be cooperating agencies in the development of the subject environmental compliance. The BIA intends to use the analysis contained within this EA, and adopt the completed EA document as analysis for National Environmental Policy Act compliance, regarding leases, easements, rights of way, and associated permits that the BIA may approve regarding Indian trust acreage.

Special Criteria Summary

Users:

- Primary

Municipal and Rural residences of the Blackfeet Nation, Indian Health Service, The Town of Browning, East Glacier Water and Sanitary District and Glacier Park Incorporated, commercial facilities, development projects, and travelers through area.

- Secondary

Rural Development/Rural Utilities Services; Corps of Engineers; Montana Game Fish and Parks, Motana Departments of Transportation, and Environment Quality; U.S. Fish and Wildlife Service; State Historic and Preservation Officer; Affected Utilities; City Government; Area Landowners; Sportsmen; Environmental Groups; Environmental Protection Agency.

Code Requirements:

- Safe Drinking Water Act as amended.
- Resource Conservation Recovery Act.
- Energy and Water Conservation Act.
- Preliminary Engineering Report.
- Ten State, State and EPA Standards.
- Uniform Plumbing Code
- Uniform Fire Code
- Uniform Building Code
- Building Seismic Standards
- Occupational, Safety and Health Act (OSHA).

Restrictions and Limits:

- National Environmental Policy Act; National Historic Preservation Act; Endangered Species Act; Environmental Justice; Indian Trust Assets; Elders Group; Native American Graves Protection Act; Clean Water Act; Fish and Wildlife Coordination Act; Migratory Bird Treaty Act; Montana Environmental Administration.
- Section 10, 404 Permitting, administered by Corps of Engineers.
- Section 404 Permitting, administered Tribe and State.
- Burn and solid waste disposal permits for Montana of Natural Resources, Office of Air Quality and Solid Waste; Blackfeet Environmental Office; Storm Water Discharge Permit; State Coordinating Committee.
- Road crossing under Federal and State controlled highways and Burlington Northern Railroad must be placed without using open cut procedures. Road crossing regulations for BIA, counties, and cities.
- Cultural resource clearance from Montana State Historical Society; Tribal Historic Preservation Officer; Advisory Council on Historic Preservation.
- Davis Bacon & TERO Wage Rate.

Design History:

- Provide water for the municipal and rural households within the Blackfeet Nation within funding limits.

Function Analysis

Component	Active Verb	Measurable Noun
Community Water Project	Protect Allow Develop Create Ensure Ensure Payoff Supply Minimize Ensure Improve Improve Ease Centralize Consolidate	Health Growth Economy Jobs Supply Safety Rural Development Water Rates Affordable Supply Services Education Operation Operation Service
Water Supply	Ensure Ensure Ensure Allow Allow Create	Volume/Capacity Quality Longevity Growth Multiple Use Void
Intake	Access	Supply
Piping	Transport Protect Control Maintain Maintain	Water Water Water Pressure Void
Screen	Remove Protect Trap Remove Snag	Debris Fish Algae/Moss Moss Anchors
Pipe Supports	Support Restrict	Pipe Movement
Pumps	Control Move Add Use	Flow Water Energy Energy
Controls	Control Regulate Monitor	Flow Pressure Quality

Function Analysis

Component	Active Verb	Measurable Noun
	Acuate Start Simplify Call Monitor Record Safeguard Display	Valves Pumps Operation Operator System Data System Information
Vertical Wells	House Maintain Maintain Allow Measure Catch	Pump Void Positive Suction Head Maintenance Water Level Sediment
Concrete Cap	Protect Support Sanitary	Well Casing Well Casing Seal
Control Building	House Give Protect Maintain Provide	Controls Shelter Controls Environment Power
Blowoff Piping	Clean	Screen
Excavation/Backfill	Remove Allow End Protect Stabilize Strengthen	Soil Installation Workers Pipe Pipe Pipe
Valving	Control Allow	Flow Accessibility
Directional Drilling/Boring	Allow Reduce Create Endanger Safeguard	Installation Impact Savings Worker Worker
Main Power	Move	Water
Access Road	Ensure Ensure Allow Allow	Safety Access Access Operation

Function Analysis

Component	Active Verb	Measurable Noun
	Protect	Health
Clearing	Allow Improve Remove Pile Allow	Construction Hunting Access Trees Trees Erosion
Backup Power	Ensure	Supply
Thrust Blocking	Resist Prevent Absorb Transfer	Movement Movement Energy Force
Stream Crossing	Maintain Minimize Cross Cause	Streambed Impact Stream Sedimentation
Air/Vacuum Release Valves	Expel Reduce Prevent Protect Allow Maintain Save Create Cause Maintain Add Reduce	Air Air pressure Implosion Pipe Fill/drain Opening Energy Maintenance Surge Opening Cost Cost
Blowoff Valves	Release Release Allow Clean Drain	Air Pressure Access Pipe Pipe
Imported Pipe Bedding	Protect Strengthen Stop Provide/Enhance Ensure Increase Give	Pipe Pipe Leaks Quality Assurance Longevity Cost Warning
Surveying	Prevent Ensure Cost	Law suit Accuracy Money

Function Analysis

Component	Active Verb	Measurable Noun
	Documented Locate	Location Infrastructure
Fiber Optical Cable	Transmit Allow Collects Protects Protects Protects Maintain	Signals Control Data Pumps Pipe People Service
Pipe Weights	Reduce Prevent	Movement Flotation
Water Treatment Plant	Treat Remove Meet Protect Control Generate House/store Use	Water Impurities Regulations Health Flow Waste products Equipment/supplies Energy
Meter	Control Ensure Measure Detect Generate Control Monitor	Inventory Accountability Volume Leaks Funds Feed rates Unit costs
Foundation	Support Anchors	Building Equipment
Building	Protects Protects Protect Protects Maintain House	Equipment Operator Supplies Public Environment/atmosphere HVAC
Filtration Modules	Remove Treat Protect Protect Reduce Limit Requires Protects Requires	Impurities Water Health Public Maintenance Chemicals Backwash Environment Chemical cleaning

Function Analysis

Component	Active Verb	Measurable Noun
	Requires	Replacement
Backwash System	Cleans	Filters
	Removes	Particles
	Revitalizes	Filters
	Use	Water/Air
	Discharges	To stream
	Decreases	Production
	Increases	Production
	Uses	Energy
	Saves	Energy
Decant Settling/Basin	Removes	Particles
	Saves	Water
	Requires	Permit
Air Scour	Requires	Compressor
	Improves	Efficiency
	Makes	Noise
	Generates	Heat
	Uses	Energy
Chemical Cleaning	Creates	Hazard
	Improve	Production
	Requires	Proper disposal
	Requires	Storage
	Requires	Mixing
	Requires	Delivery
Process Control Instruments	Enhances	Efficiency
	Reduces	Expense
	Directs	Labor
	Monitors	Water Quality
	Records	Data
	Adds	Complexity
	Requires	Updating
	Requires	Training
	Coordinates	System
	Nags	Operator
Backup Power	Ensures	Supply
	Ensures	Reliability
	Heats	Building
	Requires	Fuel
Site Security (Fencing)	Protects	Facilities
	Rejects	Bears
	Protects	Public
	Fire	Protection

Function Analysis

Component	Active Verb	Measurable Noun
Access Road	Requires	Snow Removal
	Allows	Delivery
	Allows	Drainage
Roughing Filters	Removes	Large Particles
	Protects	Filters
	Requires	Cleaning
	Requires	Replacement
Disinfection	Kills	Bacteria
	Protects	Health
	Requires	Safe Storage
	Creates	Hazard/Risk
	Needs	Code
	Requires	Instrumentation
	Produces	Disinfection By-Products
	Requires	Residual
Clear Well	Meets	Regulations
	Allows	Mixing
	Ensures	Contact Time
	Controls	Operation
	Ensures	Supply
	Buffers	Supply
High Service Pumps	Deliver	Water
	Add	Energy
Chemical Storage	Ensure	Supply
	Ensure	Safety
	Restrict	Access
	Ensure	Reliability
	Requires	Proper Handling
Lab Facility	Supply	Quality Control
	Obtains	Samples
	Requires	Disposal
	Meets	Regulation
Treated Water Supply @ WTP	Supplies	Operator
	Supplies	Lab
Treated Water Pipeline	Maintains	Purity
	Requires	Monitoring
	Transport	Water
	Meet	Demand
	Size	For demands
	Allows	Flexibility
	Requires	Appurtenances
	Allows	Taps

Function Analysis

Component	Active Verb	Measurable Noun
Appurtenances	Allow Protect Offset Minimize Relieve	Flexibility Pipe Cost Maintenance Pressure
Crossings	Circumvent Maintain Preserve Maintain Install	Impediments Usage History Safety Casing
Pipe Markers	Foster	Location
Connection to Existing System	Creates Increase Creates Strains Requires Interrupt Defines Requires Requires Requires Requires Requires Requires	Happiness Rates Transition Piping Accommodation Service Boundaries Appurtenances Browning west upgrade Check valve Meters Flow control valve Master meter vault
Power Turbines	Recapture Remove Reduce Produce Requires	Cost Energy Pressure Energy Maintenance
Storage	Provide Ensure Meet Equalize Increase Creates Reduces	Insurance Supply Peak Flow Flow Disinfection Requirements Attractive Nuisance Surge
Overflow Piping	Protects Maintains Creates	Tank Level Erosion
Energy Dissipation	Prevents	Erosion
Corrosion Control	Enhance	Longevity

Function Analysis

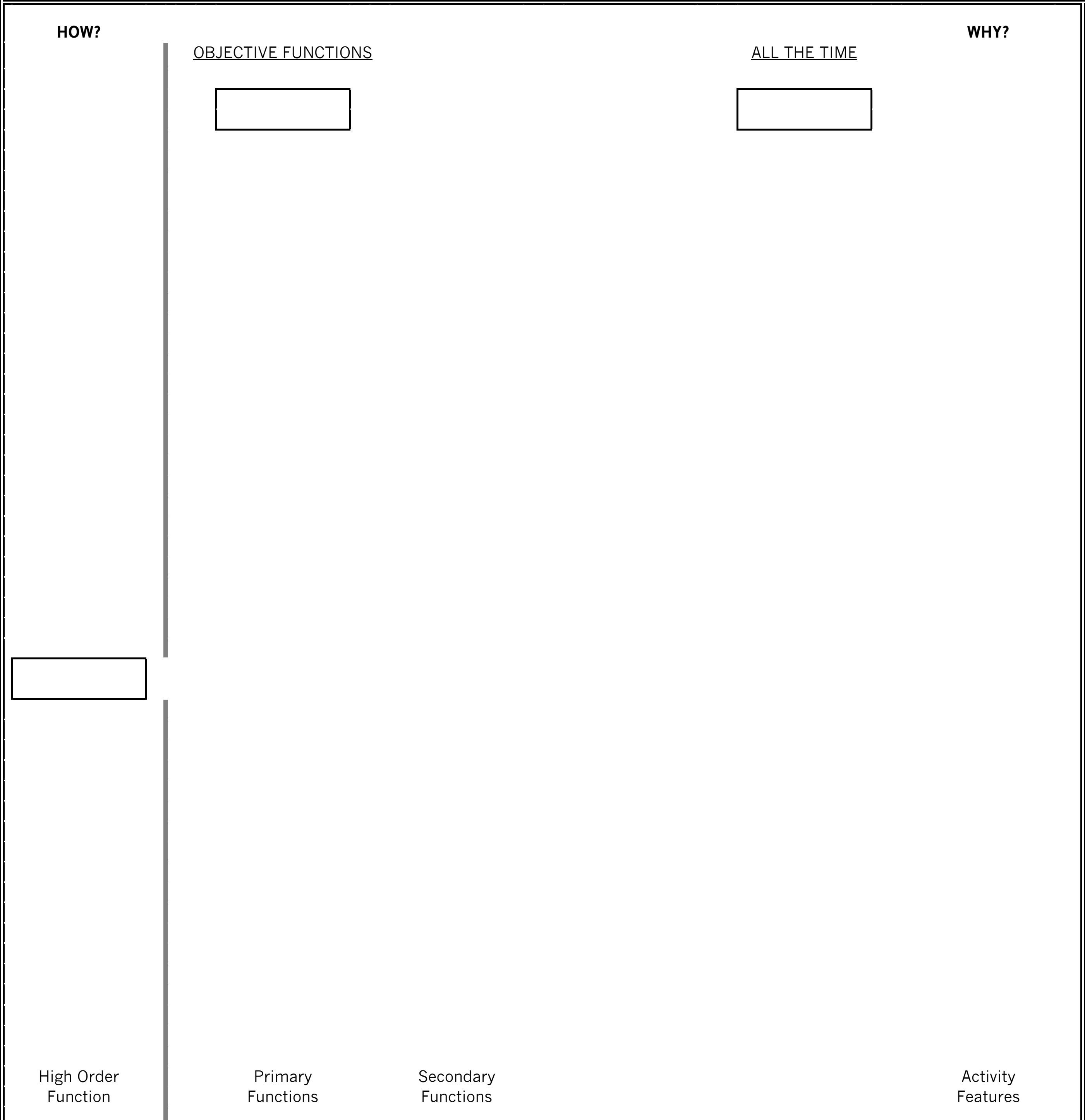
Component	Active Verb	Measurable Noun
	Prevent Prevent	Corrosion/Leaks Contamination
By Pass	Allow Allow Require More	Maintenance Inspection Valves/Pipe
Water Project Mitigation	Meets Requirements Protect Protect Protect	Federal & Tribal Wildlife & People Habitat Water Source

Function Analysis System Technique (FAST)

The Value Study Team used the function-analysis process to generate a Function Analysis System Technique (FAST) diagram, designed to describe the present solution from a functional point of view. The FAST diagram helped the Team identify those design features that support critical functions and those that satisfy noncritical objectives. The FAST diagram also helped the Team focus on potential value mismatches, and generate a common understanding of how project objectives are met by the present solution.

xxx - CONCEPTUAL DESIGN

FUNCTION ANALYSIS SYSTEM TECHNIQUE (FAST) DIAGRAM



Activity-Oriented FAST Diagram

COST MODEL AND ESTIMATE INFORMATION

The Value Study Team cost model is based on the preliminary design estimates provided by the design team for the preferred project design. The cost model was developed by the Value Study Team and was used to focus on features with the greatest potential for savings and to highlight areas of value mismatch.

Unit prices were reviewed by the Value Study Team members, to ensure reliability and applicability.

Cost avoidance/savings and the original design concept estimates are of the same general level of development, although these costs may vary as final designs are pursued.

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Second Page of cost model

Proposal No. 1A

Description

Proposal No. 1A. Browning Transmission Main Revision.

Proposal Description:

- The original concept calls for a 20-inch PVC water main to run from the water treatment plant to Browning.

- The VE concept calls for installing the smallest pipe sizes necessary to meet the design flow of 2,500 gpm. The range of anticipated sizes necessary to serve Browning are 12-inch – 18-inch. A review of the transmission main profile shows a large portion of the main can be 12-inch AWWA C900 Pipe Class 200. This will produce a considerable savings over the proposed 20-inch main.

Critical Items to Consider:

- Appropriate location of PRV’s to protect the transmission main from dangerous pressures.
- Flow control measures to assure flows do not exceed the design flow of 2,500 gpm.
- A portion of the main appears to require ductile iron pipe to handle high pressures. The VE team recommends giving special attention to corrosion protection. Wrapping the pipe in HDPE in accordance with AWWA and joint bonding are minimum treatment. Contacting the natural gas pipeline owner and conducting soil tests are other considerations.
- Consideration for removing air from the line downstream from the 500,000 gallon storage tank if high demands drain the tank.

Ways to Implement:

- Provide a detailed engineering model of the transmission main looking at pressures and potential surges. The VE team completed a preliminary design needing further investigation and modeling.

Changes from the Baseline Concept:

- The baseline concept called for a single size to accomplish water transmission. The VE team proposes smaller and more economical pipe where technically appropriate.

Advantages	Disadvantages
· Smaller pipe is PVC or HDPE rather than DIP and is less expensive to install and repair.	· Design will require more detailed engineering analysis.

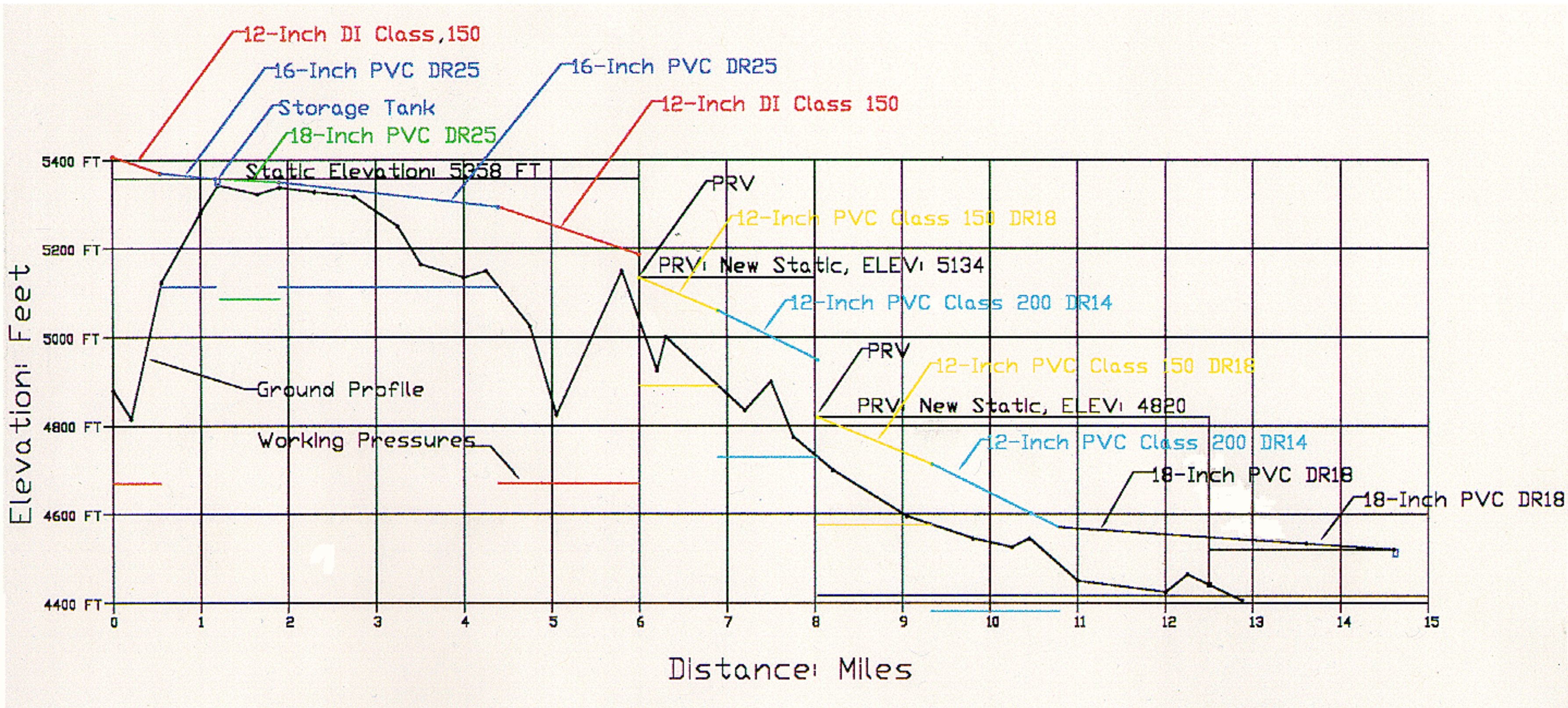
Potential Risks

The VE team did not identify risks beyond that of the baseline concept.

Proposal No. 1A

Cost Items	Nonrecurring Costs
Original Baseline Concept	$4,000,000
Value Concept	$3,500,000
Savings	$500,000
Value Study Costs	$29,600
Implementation Costs	$0
Net Savings	**$470,400**

Figure 8. Preliminary Hydraulic Grade Line and Pipe Sizing Pipeline Route to Browning.



Proposal No. 1B

Description

Proposal No. 1B. Utilize depth of bury construction in lieu of line on grade construction.

Proposal Description:

- The original concept calls for utilizing the line on grade construction technique. This requires the contractor to maintain specific alignments and grades while installing the pipe. This results in potentially deeper trenches, which requires additional leveling equipment and extensive construction surveys.

- The VE team proposes utilizing the depth of bury construction technique. This requires the Contractor to maintain the minimum pipe cover required in the area and allows flexibility (within the ROW) for moving the alignment around unforeseen obstacles.

Critical Items to Consider:

- Owner's representative must diligently assure that combination air release valves are installed at appropriate locations.
- Owner's representative must diligently assure that the Contractor adheres to pipe manufacturer's recommendations for pipe joint deflections and laying radii.
- Owner's representative must diligently assure that pipeline is installed to required depth.

Ways to Implement:

- Describe pipe installation requirements in the contract specifications and detail what the Contractor shall accomplish at points where air might get trapped.

Changes from the Baseline Concept:

- A construction technique is changed.
- Plans are less detailed.
- The installation of the pipe is made easier.

Advantages	Disadvantages
· Installation costs are decreased. · Level of detail required on plans is relaxed reducing the cost of preparing plans. · Potential for deep trenches is decreased. This improves worker safety and lessens the chance of unforeseen site conditions (i.e. Groundwater). · Fewer survey controls are required for the construction survey.	· Additional combination air release valves might be necessary. · Chance that a combination air release valve will be incorrectly placed is increased. · Record drawings will need to utilize GPS to accurately locate installed pipe and appurtenances.

Proposal No. 1B

Potential Risks

If combination air release valves are inappropriately placed, transmission capacity can be decreased.

Cost Items	Nonrecurring Costs
Original Baseline Concept	$85,000
Value Concept	$0
Savings	$85,000
Value Study Costs	$29,600
Implementation Costs	$0
Net Savings	**$55,400**

Proposal No. 1C

Description

Proposal No. 1C. Decrease the size of the proposed 500,000 gallon water storage tank.
Note: The cost of this tank was not included in the cost estimates of the "Preliminary Engineering Report." However, the design team considered it as part of the project cost and presented cost savings.

Proposal Description:

- The original proposal calls for constructing a 500,000 gallon storage tank on the transmission line to Browning.
- The VE team proposes constructing a smaller tank, sized on pump run time requirements. A 100,000 gallon tank with 50,000 gallons of operational storage would keep pump starts to less than once an hour and would generally provide long pump run times.

Critical Items to Consider:

- Tank must be sized so that supply pump run times are adequate and unnecessary pump cycling does not occur.
- Consideration of both above and below ground installation should be considered.

Ways to Implement:

- Work with pump manufacturers to determine optimal run times and what constitutes dangerous cycling. Design tank to eliminate this possibility.

Changes from the Baseline Concept:

- Original concept intended to provide additional storage in the system. Analysis shows existing storage is adequate. The new concept proposes to size the tank to provide for appropriate pump operation only.

Advantages	Disadvantages
· Significant savings can be realized if a large reduction is possible. · Smaller tank will result in less maintenance cost.	· A decrease in tank size will increase pump cycling. If cycling is beyond manufacturer's recommendations, pump life might be shortened. · A decrease in tank size reduces available storage. (A minor point. Analysis shows storage is adequate for Browning in the design year.)

Potential Risks

The VE team did not identify potential risks.

Cost Items	Nonrecurring Costs

Proposal No. 1C

Original Baseline Concept	$500,000
Value Concept	$150,000
Savings	$350,000
Value Study Costs	$29,600
Implementation Costs	$0
Net Savings	**$320,400**

Proposal No. 2A

Description

Proposal No. 2A. Calcium Hypochlorite Disinfection System.

Baseline Concept

- Figure 6. shows chlorine injection before the clearwell. Baseline cost is an estimate for injecting chlorine at a dose of 2.5 mg/L. Costs are estimated using WaTER, a USBR water treatment cost estimation program. The System is as described in EPA-600/2-79-162b, Estimating Water Treatment Costs.

Proposal Description:

- Utilize hypochlorite for disinfection generated from calcium hypochlorite pellets, which will also help stabilize the product water.

Critical Items to Consider:

- Reliability.
- Langelier Saturation Index (LSI) (The effect of pH on the equilibrium solubility of $CaCo_3$.)
- Ease of operation.
- Delivery of bulk disinfectant to the water treatment plant during the winter months.
- Storage requirements of the bulk disinfectant.

Ways to Implement:

- Design and construct an onsite calcium hypochlorite disinfection system.
- Incorporate storage space into water treatment plant design to facilitate the storage of an adequate supply of granular calcium hypochlorite for the winter months.
  Investigate dose requirements for stabilization - will need to add approximately 6 mg/L lime in addition to the disinfectant.
-

Changes from the Baseline Concept:

- Disinfection with chlorine gas injection is the original concept.
- Stabilization of the finish water was not originally considered but will be required to prevent corrosion of system components.

Proposal No. 2A

Advantages	Disadvantages
· Capital cost for calcium hypochlorite treatment is approximately two to three times less than chlorine gas. · Cost range for calcium hypochlorite is \$1.45 to \$1.95 per pound, which is \$1.00 per pound cheaper than chlorine gas. · No off gassing, therefore no separate room is required. · The calcium added to the water will provide adequate stabilization to the finish water. · System is simple to install, operate and maintain. · Bulk chemical delivery (50 or 100 pound bags) is easier to handle and can be accomplished easier in the winter months if necessary. · Provides consistent chlorine strength. · Improved safety and potential hazards to employees. · No waste byproducts. · Avoids requirements of periodic risk analysis for chlorine gas	· Potential health hazard. · Dry storage area required. · Disposal of hydrogen gas.

Potential Risks

- Caustic burns skin on contact.
- Inhalation risks if negligent improper operation.

Cost Items	Life-Cycle Costs
Original Baseline Concept Chlorine Gas, Lime dose	\$180,109
Value Concept - Calcium Hypochlorite	\$144,904
Savings	\$35,205
Value Study Costs	\$29,600
Implementation Costs	\$0
Net Savings	**\$5,605**

Life Cycle Costs For Proposal 2A.

Life Cycle Costs For Proposal 2A Graph

Proposal No. 2B

Description

Proposal No. 2B. Comparison of pretreatment option for the micro-filtration system.

Proposal Description:

- Consider two options, Sand Filter and Cartridge filter to remove the larger suspended solids.

Critical Items to Consider:

- Adequate removal of suspended solids.
- Disposal of solids and backwash water.
- Disposal of used cartridges.

Ways to Implement:

- Cost comparisons of capital and operation and maintenance of two types.
- Design and construct pretreatment system.
- Incorporate pretreatment system into water treatment plant design to facilitate the storage of an adequate supply of filter cartridges for the winter months.

Changes from the Baseline Concept:

- Details of the roughing filter considered in the original concept were not included in the Preliminary Engineering Report.
- Original concept assumed to be sand filter.

Advantages	Disadvantages
· Lower capital costs. · Ease of installation. · Ease of operation · Minimal space requirement · Lower O & M costs.	· Waste product disposal. · Cartridge disposal.

Potential Risks

The product requires proper disposal.

Cost Items	Life-Cycle Costs
Original Baseline Concept Sand Filter	$330,313
Value Concept - Calcium Hypochlorite	$242,549

Proposal No. 2B

Savings	$87,764
Value Study Costs	$29,600
Implementation Costs	$0
Net Savings	**$58,164**

Life Cycle Costs For Proposal 2B.

Life Cycle Costs For Proposal 2B Graph

Proposal No. 3

Description

Proposal No. 3. Minimize need for backup emergency power.

Proposal Description:

- Use capacity in water storage tanks and transmission mains to supply East Glacier and Browning with a minimum of one day average design flow during a power outage. Use generator at the water treatment plant to power controls and basic building operation.

Critical Items to Consider:

- Assumptions:
  - Power outage duration; one day.
  - Available storage; storage tanks half full, demand at year 2020 average daily flow.
    - East Glacier; Available water in storage = 0.15MG; Demand = 0.135 MGD
    - NOTE: The East Glacier. System design basis for average daily flow is based on highest use month, July 1994, average flows are based on annual average of 49.4MG.
    - Browning; Available water = 1.76 MG (0.9 MG in storage + >0.86MG in pipeline); Demand = 1.73MGD.
  - Power outages occur 6 times per year for 24 hours each.
- Ten State Standards states that water may be pumped to meet the average day demand.

Ways to Implement:

- Install an 80 KW propane generator at the water treatment plant. This will allow operation of the control system as well as basic services, like heat, de-humidifier, lights, etc.
- To protect the intake controls from freezing, bury the pump and control station in a vault or install a small propane heater to heat strips in the control panel, loop through floor, walls.

Changes from the Baseline Concept:

- The baseline concept provided for one generator. However, since the intake and water treatment plant are separated by more than two miles, two generators would be necessary to operate the plant during power outages.
- This proposal uses the $40,000 single generator as a base for analysis of the storage as an alternative to generators.
- The Lifecycle Cost Analysis included here also estimates the cost for two generators installed to provide average daily flow capacity during power outage.

Proposal No. 3

Advantages	Disadvantages
· The cost to purchase and to operate generators for frequent short power outages is decreased significantly. · Can meet Ten State Standard recommendations to supply average day.	· If a power out is longer than a few days, water will have to be rationed. · Difficulty in keeping water fresh in storage tanks during periods of low flow.

Potential Risks

If a power out is longer than a few days, water will have to be rationed.

Cost Items	Life-Cycle Costs
Original Baseline Concept	$104,944
Value Concept	$33,141
Savings	$71,803
Value Study Costs	$29,600
Implementation Costs	$0
Net Savings	**$42,203**

Life Cycle Costs For Proposal 3.

Life Cycle Costs For Proposal 3 Graph

Proposal No. 4

Description

Proposal No. 4. Intake structure, intake pipeline and raw water pipeline to water treatment plant.

Proposal Description:

- Construct intake line into Two Medicine Lake, install 4 wells, casing/pumps/valves, construct pump control building and transmission line to water treatment plant.

Critical Items to Consider:

- Intake line to be at proper grade to prevent airlock.
- Include integral air line for cleaning for screen.
- Size pumps to meet peak demand, redundant or back up on line.
- Size raw pipeline to meet flow requirements to treatment plant and insure protection of environmentally sensitive intake site.

Ways to Implement:

- Evaluation of costs for deep excavation, shore to lake bottom and/or a combined excavation and directional boring/drilling.
- Define allowed activities in area and insure contract, environmental and cultural compliance.

Changes from the Baseline Concept:

- Principal adjustments involves increasing pump size/hp from 50 to 75.
- Modify type of pipe used to transport water from intake structure to water plant.

Advantages	Disadvantages
· Insures capability of meeting peak demand. · Includes backup pumps. · Protection of environmentally and culturally sensitive area. · Meets needs of the people within the project.	· Requires deep excavation.

Potential Risks

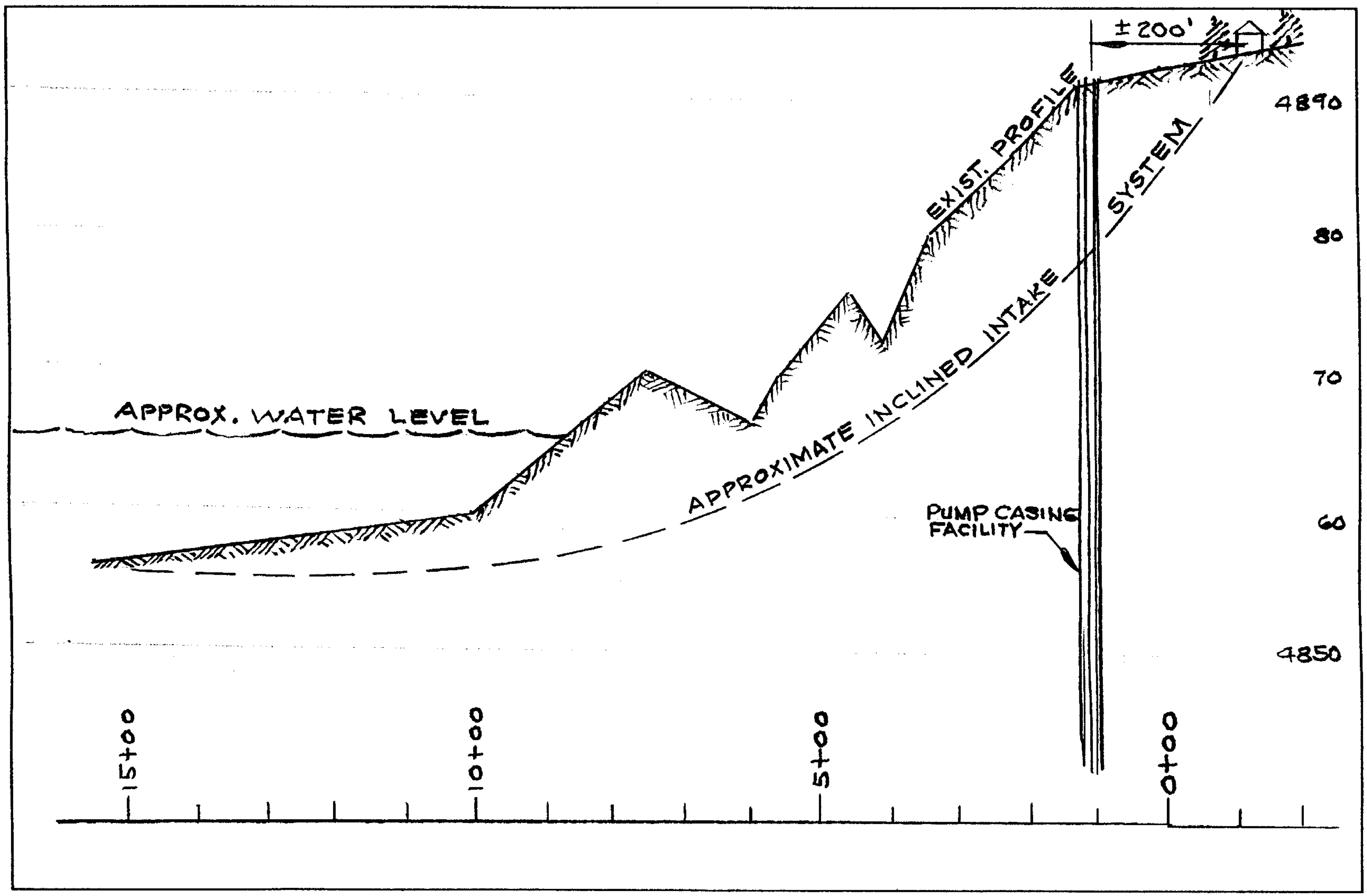
Any risk that would be associated with this project would be that risk associated with working in extreme weather conditions and in deep excavations.

Cost Items	Life-Cycle Costs

Proposal No. 4

Original Baseline Concept	$2,222,499
Value Concept	$2,176,260
Savings	$46,239
Value Study Costs	$29,600
Implementation Costs	$0
Net Savings	**$16,639**

Figure 9. Intake Profile.



Disposition of Ideas

Value Study Elements Considered as Potential Proposals and Their Disposition	
Idea	**Disposition**
Smaller transmission pipeline to Browning.	Further developed in proposal No. 1A and 1B.
Disinfection Options a. Chlorine b. Chloramines c. Onsite (Hypochlorite solution) d. Dioxide	Further developed in proposal No. 3A and recommended as item for further study.
Accessibility to WTP site.	Recommended as item for further study.
Restrict lake use after intake installed.	Recommended as item for further study.
Restrict lake and area water shed protection	Recommended as item for further study.
Investigate all pipe materials.	Further developed in proposal No. 1A and 1B and recommended as item for further study.
Treatment adjustments for raw water. a. corrosive lead & copper. b. pH.	Further developed in proposal No. 3A and 3B.
Use vertical well caisson in lieu of 4 vertical wells	Recommended as item for further study if current intake design isn't constructed during winter of 2001/2002.
Use inclined intake system.	After initial consideration by the VEST this proposal was dropped further consideration due to increased costs and increased difficulty in maintenance.
Confirm reliability of stream flow data.	Beyond scope of this study.
Verify watershed yield.	Beyond scope of this study.
Recommended minimum stream flow.	Recommended as item for further study.
Investigate backup power options.	Further developed in proposal No. 4 .
Investigate energy efficiency costs	Further developed in proposal No. 4 .
Use soft starts of VFDs	Recommended as item for further study.
Put pump controls into SCADA contract.	Recommended as item for further study.
Put in turbine to generate power on Browning line	Recommended as item for further study.
Put PRVs in Browning line.	Included in the concept presented in the Preliminary Engineering Report.
Put in flush valves in transmission mains.	Included in the concept presented in the Preliminary Draft of the Final Engineering Report.
Put flushing water to good use.	Recommended as item for further study.
Put in air valves and blowoff.	Included in the concept presented in the Preliminary Draft of the Final Engineering Report.
Fire Departments access to flush valves.	Recommended as item for further study.
Isolation valves on transmission line.	Included in the concept presented in the Preliminary Draft of the Final Engineering Report.
Integrity monitoring at WTP	Included in the concept presented in the

Disposition of Ideas

Value Study Elements Considered as Potential Proposals and Their Disposition	
Idea	**Disposition**
	Preliminary Draft of the Final Engineering Report.
Install master meters at WTP, Browning & East Glacier main transmission pipelines	Included in the concept presented in the Preliminary Draft of the Final Engineering Report.
Meter all users	Included in the concept presented in the Preliminary Draft of the Final Engineering Report.
Use Midvale Creek as supplementary raw water source pump to WPT	Not considered feasible.
Use existing system for backup to Browning	Included in the concept presented in the Preliminary Draft of the Final Engineering Report.
Treat existing Browning source to meet peak demand.	Recommended as item for further study.
Treat existing Glacier Park Inc. source to meet peak demand.	Not considered feasible.
Treat abandoned EGWSD to meet peak demand.	Not considered feasible.
Analyze storage tank capacities.	Further developed in proposal No. 1 shown to be adequate.
Single tank for East Glacier.	Recommended as item for further study.
Single tank for Browning	Recommended as item for further study..
Incorporate anticipated growth NW of Browning ie. Transmission line to tank NW and Back feed route.	Recommended as item for further study.
Use raw water for GPI Golf Course.	Included in the concept presented in the Preliminary Draft of the Final Engineering Report.
Develop criteria for treatment process.	Recommended as item for further study.
Use direct filtration.	Not considered feasible.
Acquisition of O&M equipment.	Recommended as item for further study.
Only install underground water blowoff appurtenances now.	Not considered appropriate since other local water systems utilize similar systems to clear screens.
Review usage design criteria.	After review, design criteria considered adequate.
Blackfeet utilities acquire EGWSD and allow to operate under BFO.	Included in the concept presented in the Preliminary Draft of the Final Engineering Report.
Research energy conservation alternatives.	Recommended as item for further study.
Wind turbines at 500,000 tank.	Not considered feasible.
One contract for SCADA.	Recommended as item for further study.
Use radio for SCADA. Fiber optic Internet Satellite Cell phone	Recommended as item for further study.

Disposition of Ideas

Value Study Elements Considered as Potential Proposals and Their Disposition	
Idea	**Disposition**
Corrosion protection.	Recommended as item for further study.
Emergency subsistence quarters.	Recommended as item for further study.
Operator training.	Included in the concept presented in the Preliminary Draft of the Final Engineering Report.
Contingency plans.	Recommended as item for further study.
Produce bottled water.	Recommended as item for further study.
Use two pipes in lieu of one on the Browning transmission pipeline.	Not considered feasible for this project since this line size was reduced to 12-inch in Proposal No. 1.
Use depth of bury for pipe design.	Further developed in proposal No. 1.
Use Global Positioning Systems for record drawings.	Further developed in proposal No. 1.
Directional boring streams RR & Highways.	Recommended as item for further study.
Expand dead pool capacity.	Recommended as item for further study.
Facilitated leak detection.	Recommended as item for further study.
Reverse Osmosis in treatment plant potable water supply.	Ultra Violet disinfection is considered more cost effective for this application.
Conduct VE Study.	Done.
Identify all peak and fire flow and make sure flow and storage are adequate.	Included in the concept presented in the Preliminary Draft of the Final Engineering Report.
Good location of storage tank.	Recommended as item for further study.
Place storage tank NW of Browning.	Recommended as item for further study.
Review extra storage verses backup power.	Further developed in proposal No. 4.
Utilize high pressure and volume in trans line to Browning to serve area NW of Browning	Recommended as item for further study.
Identify need for PRV's and install to protect pipe and people.	Included in the concept presented in the Preliminary Draft of the Final Engineering Report.
Install turbine to generate electricity and remove energy.	Recommended as item for further study.
Build fences around intake WTP and storage to maintain supply.	Included in the concept presented in the Preliminary Draft of the Final Engineering Report.
Manage Lower Two Medicine Lake to ensure supply.	Recommended as item for further study.
Use PVC bladders for storage	Not considered feasible.
Use reinforced concrete for ground/buried storage tanks.	Recommended as item for further study.
Consolidate storage (one tank) Eliminate one H/S pump station	After initial consideration, not considered feasible and dropped from further consideration.
Eliminate some storage tanks.	After initial consideration, not considered feasible and dropped from further consideration.

Disposition of Ideas

Value Study Elements Considered as Potential Proposals and Their Disposition	
Idea	**Disposition**
Manifold high service pump station piping for flexibility and consider more smaller pumps or VFD's instead a few larger pumps.	After initial consideration, recommended as item for further study.
Annual rain dance.	As needed.
Use pipeline for tanks.	Determined not to be feasible due to the cost savings anticipated by reducing pipe size in Proposal No. 1.
Use bolted tanks.	Recommended as item for further study.
Use welded steel tanks.	Recommended as item for further study.
Use elevated tanks	Recommended as item for further study.
Restrict/Plan for taps	Recommended as item for further study.
Construct multiple pipe system for redundancy	After initial consideration, not considered feasible and dropped from further consideration.
Tapping Ordinance.	Recommended as item for further study.
Utilize bedding-identify bedding source.	Further developed in proposal No. 1 and included in the concept presented in the Preliminary Draft of the Final Engineering Report..
Require adequate record drawings.	Included in the concept presented in the Preliminary Draft of the Final Engineering Report.
Keep record drawings updated.	Recommended as item for further study.
Conduct geological study, seismic hazards.	Will be conducted prior to construction of pipelines.
Conduct Resistivity Analysis, Corrosion Protection study if application.	Will be conducted prior to construction of pipelines.
Identify soils along route to ensure proper design of thrust blocks.	Will be conducted prior to construction of pipelines.
Materials specifications for taps.	Recommended as item for further study.
Pipe alignment with flat bends.	Included in the concept presented in the Preliminary Draft of the Final Engineering Report.
Over specify pipe materials and installation (exceed standards).	Not considered economically feasible.
Relieve pressure.	Included in the concept presented in the Preliminary Draft of the Final Engineering Report.
Install blow off valve.	Included in the concept presented in the Preliminary Draft of the Final Engineering Report.
Install PRVs.	Included in the concept presented in the Preliminary Draft of the Final Engineering Report.
Install surge tower/tank.	Recommended as item for further study.
Conduct hydraulic analysis.	Included in design phase of project.
Use soft start Variable Frequency Drive	Recommended as item for further study.

Disposition of Ideas

Value Study Elements Considered as Potential Proposals and Their Disposition	
Idea	**Disposition**
Locate tank midway to Browning build distribution system.	Recommended as item for further study.
Install underground pipe warning tape.	Recommended as item for further study.
Non ferrous pipe install sonic taps.	Recommended as item for further study.
Ongoing surface observation twice a week.	Recommend that this item be established as an O&M policy.
Take aerial infrared photos for leak detection.	Recommend that this item be established as an O&M policy.
Use weights to resist flotation.	Included in the concept presented in the Preliminary Draft of the Final Engineering Report.
Reduce surge	Recommended as item for further study.
Install tanks	Included in the concept presented in the Preliminary Draft of the Final Engineering Report.
Install tower/tanks	Included in the concept presented in the Preliminary Draft of the Final Engineering Report.
Install slow closing valves	Recommended as item for further study.
Minimize valves	Recommended as item for further study.
Install smaller pipe	Further developed in proposal No. 1.
Install elastic pipe (plastic)	Further developed in proposal No. 1.
Maintain valves PRV air/relief, flow control, check.	Recommend that this item be established as an O&M policy.
Treat Water	
Install Reverse Osmosis	Not considered feasible.
Install Zenon unit in lake	Not considered feasible.
Use UV for disinfection.	After initial consideration, not considered economically feasible and dropped from further consideration.
Evaluate alternative MF processes .	Will be evaluated during the procurement process.
Distillation.	Not considered feasible.
Chlorination.	Included in the concept presented in the Preliminary Draft of the Final Engineering Report.
Onsite Chlorine generation.	After initial consideration, not considered economically or technically feasible and dropped from further consideration.
Slow sand filter.	After initial consideration, not considered economically feasible and dropped from further consideration.
Evaluate alternative membrane treatment.	Recommend tribe investigate intra gated

Disposition of Ideas

Value Study Elements Considered as Potential Proposals and Their Disposition	
Idea	**Disposition**
	membrane treatment using Miicro and Ultra filtration to reduce level of Total Organic Carbons.
PAC filters	Recommended as item for further study.
Conventional	Not considered feasible for this project.
Pretreat water at intake with flocculent.	Recommended as item for further study.
Stabilize treated water for corrosion control.	Further developed in proposal No. 3a.
Boil water.	Not a viable option, East Glacier currently on boil order.
Eliminate Clear well.	Not considered feasible need pump equalization storage.
Deliver bottled water.	Not considered economically feasible.
Provide sample tap to distribution system.	Recommend that this item be included in design.
Onsite treatment for WTP use.	Further developed in proposal No. 3a.
Provide adequate sample taps.	Included in the concept presented in the Preliminary Draft of the Final Engineering Report.
Back route small PVC line to WTP for in plant use.	Not considered economically feasible.
Ultrafiltration	Recommended as item for further study.
Add addition filter module to maximize recycle period.	Recommended as item for further study.
Ozone for disinfection.	Not considered feasible
Clorox for disinfection.	The use of Calcium Hypochlorite superior product for this system
Utilize the first reaches treated water mains for contact time.	Recommended as item for further study.
Increase pipe size.	Not considered feasible.
Use new East Glacier and Browning tanks for contact time.	Recommended as item for further study.
Optimize pipe size.	Will be conducted during design of pipelines.
Use gravity.	Included in the concept presented in the Preliminary Draft of the Final Engineering Report.
Fill stations for private water haulers.	Recommended as item for further study.
Rural distribution areas.	Recommended as item for further study.
Serve Cut Bank.	Beyond scope of this study and available water supply.
Serve Blackfoot, Bear Paw, Blevins and Heart Butte.	Recommended as item for further study.
Solar panels for electricity in remote locations.	Recommended as item for further study.
Windmills for energy.	Recommended as item for further study.

Disposition of Ideas

Value Study Elements Considered as Potential Proposals and Their Disposition	
Idea	**Disposition**
Nuclear power plant.	Not considered feasible.
Fuel Cells (hydrogen).	Recommended as item for further study.
Power take off pump heads.	Recommended as item for further study.
Propane or diesel fuel.	Will be used for backup power generation and recommended as item for further study.
Install power lines.	Included in the concept presented in the Preliminary Draft of the Final Engineering Report.
Install turbines on line between proposed storage tank and Browning.	Recommended as item for further study.
Natural Gas.	Not economically feasible in this area.
Turbine in Two Medicine Dam.	Recommended as item for further study.
Stage installation.	Recommended as item for further study.
Oversize WTP for night operation for off peak power.	Plant anticipated to operate a maximum 12 hours per day.
Use backup power to shave peaks.	Recommended as item for further study.
Use radiant heaters in WTP.	Recommended as item for further study.
Heat pumps (water).	Not considered feasible.
Utilize generated heat.	Included in the concept presented in the Preliminary Draft of the Final Engineering Report.
Passive solar window.	Recommended as item for further study.
Construct building underground.	Not considered feasible.
Construct building into slope.	Not considered feasible.
Control humidity.	Recommend that this item be included in design and established as an O&M policy.
Develop scope/capability of control system (team).	Recommended as item for further study.
Satelite phones or microwave for SCADA.	Recommended as item for further study.
Relay control logic.	Not considered feasible.
Digital radio system.	Recommended as item for further study.
Power RTUs with solar cell.	Recommended as item for further study.
Video surveillance at WTP and Intake.	Recommended as item for further study.
Leased telephone lines.	Recommended as item for further study.
Establish security protocal for tech O&M system person with technical contract.	Recommend that this item be established as an O&M policy.
Access Supply	

Disposition of Ideas

Value Study Elements Considered as Potential Proposals and Their Disposition	
Idea	**Disposition**
Adjust screen size.	Screen meets requirements of USFWS
Eliminate screen.	Not considered feasible.
Removable well screens at four wells.	Not considered feasible.
Place Micro Filtration in lake.	Not considered feasible.
Continued use of Midvale Creek new removal system.	Not considered feasible.
Radial collector well.	Not considered feasible.
Infiltration gallery.	Not considered feasible.
Ute water screen.	Not considered feasible.
Clean screen by back flushing from WTP.	Recommended as item for further study.
Anti microbial paint on Intake screen.	Recommended as item for further study.
Create watershed management plan.	Recommended as item for further study.
Direct 40 Mile Creek to Lower Two Medicine Lake.	Not considered feasible.
Direct Filtration.	Not considered feasible for this project.

Considerations in Choosing a Micro- or Ultra-filtration System

Configuration

Microfiltration (MF) and Ultrafiltration (UF) membranes come in a variety of configurations and have a wide range of retention abilities. There are in-side out flow systems and out-side in; fine fibers and small tubes; dead-end flow and cross-flow, with or without re-circulation. In deciding which type to use, consider the types of fouling matter that may be in the source water. In the case of the Lower Two Medicine Reservoir, the fouling matter may be fine silt or algae that will be difficult to remove from the interior of a fine fiber. Similarly, a dead-end filtration system will trap silt inside the module. The best configurations for this project will be outside-in fine fibers or small tubes using cross-flow filtration. Re-circulation is needed sometimes to maintain higher productivity levels. It is desirable to have the ability to operate with re-circulation if it is needed during high turbidity seasons.

TOC Removal Efficiency

The Stage 1 Disinfectant and Disinfection Byproducts Rule requires 35% reduction in TOC for surface water that has less between 2 and 4 mg/L TOC and 60 mg/L alkalinity or less. The analysis included with the Draft Engineering Report had 3 mg/L TOC and 44 mg/L alkalinity. At this time, the state of Montana has not made a determination on how MF will be regulated. Until then it must meet the SWTR requirements. MF does not retain TOC by itself, however a tighter UF membrane might. Powdered activated carbon (PAC) can enhance TOC retention. The PAC is added to the feed tank ahead of the MF and the retentate is re-circulated back to the feed tank. Periodically the PAC is discarded. It may be incinerated and re-used or placed in a landfill. Jar tests need to be performed to determine the best PAC dose.

Performance in High and Low Turbidity

Turbidity is another indicator of pathogen retention. The requirement is less than 0.3 NTU for 95% of the measurements each month with no measurement over 1.0 NTU. Some MF or UF systems perform more reliably in high Total Suspended Solids (TSS) conditions. Others perform just as well with low TSS. Test systems under consideration during both conditions. If it is infeasible to wait for high TSS situations to come along, simulate these conditions by adding silt from the bottom of the reservoir to the feed tank.

Operationally Robust

What are the maximum and minimum flow, differential and system pressures? Membrane systems have optimal operating conditions where performance is high, fouling rate is low and energy input is a minimum. Pilot tests must determine this window of operation. The window must be re-evaluated on the full size system.

Controls

Many MF/UF systems have automatic backwash cycles. These may be controlled by a timer, a set point on the differential pressure, or some other electronic indicator. It is best to have the backwash controlled by differential pressure. The optimum set-point is set by the manufacturer based on pilot studies during different operating conditions. The operator must have the ability to change the set-point based on experience. It is understandable if the manufacturer wants to maintain sole control of this function, but there must be a representative tracking performance, water quality and backwash frequency so as to be able to determine the optimum set-point.

Considerations in Choosing a Micro- or Ultra-filtration System (Cont.)

Integrity Monitoring Capabilities
Integrity monitoring will be required of all MF/UF plants by the time they are finished deciding on the environmental regulations. Be sure that the selected system includes one or two different methods for monitoring integrity. There are two basic categories of integrity monitoring methods. Direct methods measure some parameter that changes because of a broken fiber, such as pressure hold tests, sonic testing, and microbial monitoring. Indirect methods measure a parameter that infers a breach in integrity such as particle counting, particle index and turbidity. These parameters can change because of a change in source water quality, pressure hold, or noise level and only change when a fiber is broken.

Training
Operators must be trained in how to keep operations smooth. They need to be empowered to deal with any problems that may come up. That means that they need to understand the operation of the system even though it is mainly automated. They need to know how to repair all parts of the system, how to operate the system manually, how to do a manual backwash and cleaning if necessary. The manufacturer should provide this training for at least two operators.

Stainless Steel Screens for Micro- or Ultra-filtration System

Lower Two Medicine Reservoir has very good quality water, therefore stainless steel screens should be considered in lieu of sand, multi media or cartridge filter for the roughing filter shown in Figure 6. Two screens could be alternated while one is cleaned and there would be no disposal problem as with cartridge filters.

Supervisory Control and Data Acquisition System

The Supervisory Control and Data Acquisition System (SCADA System) is the nervous system of the project and therefore requires compatibility of each component from the intake and water treatment plant through the high service and booster pump stations to the storage reservoirs and master meters to each of the bulk users. The study team recommends that the SCADA System be an indefinite quantity contract and the contractor be procured through a competitive negotiation process. This process will meet the competitive requirements for expending Federal funds and the need to retain experienced control system contractors.

Use of Variable Frequency Drives with Pump Motors

The use of variable frequency drives (VFD) in conjunction with inverter grade motors would have many benefits for this project.

- Replace the need for soft motor starts because the operator or control system is able to ramp up the motor to speed.
- Reduce the requirement for surge control because of being able to gradually increase flows and likewise being able to gradually reduce flows of each individual pump.
- The ability to match the flow of the pump station to the demand. This is especially useful in the early operation stages of the project.
- The capability of incorporating the VFD’s in the SCADA system.
- Reduces or eliminates demand charges from the local utility.

Additional Items for Further Study

Intake Structure – use well caisson instead of four vertical wells.

Advantages
Installing a caisson will result in a longer life structure, improved access to pumps in wet well and potential for boring intake line from inside of concrete caisson, eliminating need to excavate larger area. Available in pre-cast form, sections or whole. Bottom would be installed after set in place. Alternatively, the caisson could be formed and sunk in place leaving the interior to be used as the wet well. This method would require much less area for the site excavation as the installation of four separate well casings, which will disturb less area rich in environmental and cultural resources.

Disadvantages
Amount of concrete required may result in a higher initial cost of intake structure. These costs may be mitigated by reduced costs of deep excavation for the four well casings. If the caisson is located on site of planned well casings, a pump/control building will be located on top of it. A building structure on the lake shore is not suitable for visual/environmental concerns, therefore the building and caisson will be moved inland at least 200 feet. An additional 200 feet of boring will be required. Difficulty of building/installing caisson onsite during allowable construction season, Oct. 1 through March 1 will increase costs. The pump station building floor could be placed below ground level and a berm built up around the walls to reduce the visual impact. Weight of a preformed structure prohibits transport to site (bridge limitations).

Recommendation
Pursue the intake structure as planned, with further study on the caisson concept if acceptable bids for the intake are not received. If pursued, consideration should be given to locating the structure further inland.

Clearwell Considerations

The preliminary design specifies a 100,000 gallon clearwell. This provides about 40 minutes of retention/contact time inside the plant. Since the distribution system, clearwell and two storage tanks have a combined retention/contact time of approximately 13 hours. The distribution and storage tanks alone will provide the contact time required for the disinfection. It may be possible to have a smaller clearwell. However the clearwell does need to meet the standards of the Chicago Institute of Hydraulics to provide an adequate reservoir for the pump intakes. Also the required contact time must be met prior to the delivery of water to the first user, this will require onsite treatment to supply potable water to the water treatment plant and no user will be able to be served by the system from the transmission line until the contact time requirement is met.

Corrosion Protection

The study team recommends that prior to commencing final design an overall soils and stray current survey be conducted to determine the corrosion potential for each component that contains ferrous metal pipe, fittings or appurtenances. Reclamation has done much research in this area.

Additional Items for Further Study

Description	Remarks
Do not oversize the capacity of the pumps to anticipate growth.	Use smaller pumps now, then replace them with larger pumps to accommodate population growth as needed or when replacement becomes necessary.
Increase water storage to 1.5 peak demand to allow for power outages or other times when water cannot be pumped.	Current water storage is adequate to accommodate a power outage for one day during an average day of demand. Adequate storage will make reliance on back up generators unnecessary.
Install occupancy sensors on the lighting system in the water treatment plant to conserve energy.	Installation of occupancy censors in similar facilities yeilded payback and savings after 1.2 years.
Construct a metal building with energy efficient installation.	An uninsulated concrete building will cost more to heat.
Pump selection, operating methodology, and stepping up pump sizes to for variable flow applications may decrease energy consumption.	Similar facilities found a significant energy savings which paid for implementation in a short time.
Use a solar panel and 24v battery to heat controls at the intake structure. In Alternate Proposal 4 Alternative 2 there is a vault to house the conntrols rather than a building.	More efficient than using a generator and removes the need for a building.
Construct a below ground vault to house the pump controls at the intake site rather than a building.	A vault would replace the building in the original proposal. The vault would require a sump pump, dehumidifier and heater. This is based on the assumption that backup generators would not be required because of adequate storage.
Use radiant heat in the water treatment plant.	Radiant heat is more efficient and cost effective than other methods of heating a structure of this type.

List of Consultants

Consultant or Contact	Topic or Information
Name : Mr Curt Hohn Title : Manager Organization : WEB Water Development Association Address : 38462 W Hwy - Aberdeen, SD Phone ; 605-229-4729	Criteria used at WEB Rural Water for emergency water storage and for running system with emergency generators. The system consists of a water transmission with booster station and tanks in each service area. Mr. Hohn said the water tanks are sized at 1.5 X peak day demand for emergency storage. The intake and water treatment plant operated from construction in 1983 until recently without backup power. For their 40 booster stations, they use three trailer mounted US Federal surplus generators ($5,000 - $12,000 each). Each booster station is housed in an underground vault to help prevent freezing in a power outage. Vandalism is also reduced with this type of installation. They recently purchased two new generators, one for the intake and one for the treatment plant at a cost of $340,000 each. These are sized to run the plant at peak capacity (all pumps). WEB has also entered into an agreement with the local Rural Electric to use their new generating capacity for peak shaving.
Name : Mr. Robert Des Rosier Title : Director Organization : Blackfeet Utilities Commission Address : N Government Square; Main Tribal Building Browning, MT Phone ; 406-226-5528	Discussed history of power outages in the project area.
Name : Mr. Dennis Baker Title : Director of Engineering Organization : Glacier Park Inc. Address : 1 Midvale, East Glacier, MT 59434 Phone ; 406-226-5528	Discussed history of power outages in the project area.
Name : Mr. Roy Prior, PE Title : Engineer Organization : USDA Rural Development Address : Casper, WY Phone ; 307-261-6310	Discussed alternative methods of heating intake and water plant under emergency conditions. He suggested heating strips in the control panel using solar panels with a deep cycle 24 volt NiCad batteries. Radiant heat can be used for both facilities. A propane tank can be used to supply all heating or as the fuel for emergency power generation at the power plant. Meeteetse WY Microfiltration water treatment plant uses this heat system. The intake could use a small two bottle propane set up with switch over bottles (can be carried on snowmobile) or use a larger propane tank.

List of Consultants

Consultant or Contact	Topic or Information
Name : John Camden Title : Specialist Organization : Montana Department of Environmental Quality Address: Helena, MT Phone ; 406-444-4071	Suggested operating plant every other day during the winter months, utilizing larger storage tanks to avoid on off plant operation. The building will need to be insulated well and use energy efficient HVAC.
Name : Chris Cohagen Title : Salesman Organization : Power Service Inc. Address : Casper WY Phone ; 307-472-7722	Provided diesel generator capital cost estimates.
Name : Jason Bronek Title : Organization : Glacier Electric Address : Cut Bank, Mt Phone ; 406-873-5566	Cost of power for the water treatment plant and intake facilities.
Name : Dan Holland Title : President Organization : Bowers Power Address : Seattle, WA Phone ; 800-858-5881	Size and price of back-up generators for the water treatment plant and intake pumps.
Name : John Ritte Title : Organization : Northwest Pipe Fittings, Inc. Address : 404 17th Ave. NE, Great Falls MT, 59401 Phone ; 406-727-9843	Pipe sizes, specifications, adapters, controls & prices.
Name : Jonathan Eakman Title : Organization : Northwest Pipe Fittings, Inc. Address : 404 17th Ave. NE, Great Falls MT, 59401 Phone ; 406-727-9843	Prices for ductile iron pipe, fittings and accessories.
Name : Kurt Fagenstrom Title : Co-Owner Organization : Fagenstrom Co. Address : 2101 NW Bypass, Great Falls MT, 59401 Phone ;	Concrete Weights, anchors and specialty items.
Name : Gary Hendrix Title : Civil Engineer Organization : Thomas Dean & Hoskins, Inc. Address : Great Falls MT, 59407 Phone ; 406-761-3010	Project design parameters, current design concepts and features, and overall site information.

Data and Documents Consulted

Title, Author, and Date	Information
Advanced Water Treatment without Advanced Cost William B. Bowbiggin, Camp Dresser & McKee 2001 AWWA Annual Conference Proceedings	Cost comparison of treatment technologies.
Filter Backwash Recycling Rule: A Quick Reference Guide 66 FR 31086, June 8, 2001, Vol. 66 NO. 111	Recycled Backwash must be returned to the head of the treatment plant.
Interim Enhanced Surface Water Treatment Rule: A Quick Reference Guide 63 FR 69478 – 69521, December 16, 1998, Vol. 63, No. 241	Rules for surface water filtration.
Calcium Hypochlorite for Potable Water Disinfection Paul J. Granger, P.;E. Plainview Water District, Plainview, New York	Cost and dose rates for Calcium Hypochlorite vs. Sodium Hypochlorite.
Membrane Microfiltration as a Cost Effective Solution for a Small Utility M.A. Oneby, Applied Technologies, Inc. C.D. Nordgren, Ashland Water Utility, Ashland, Wisconsin William A. Ericson, Applied Technologies, Inc, Brookfield, Wisconsin. **2001 AWWA Membrane Conference Proceedings.**	Microfiltration system cost, clearwell cost.
Alternate Filtration: Placing New Technology in an Old Regulatory Box. Chris R. McMeen, Washington State Dept. of Health **2001 AWWA Membrane Conference Proceedings**	Establishing log removal credits for alternate filtration technology.
Overview of Regulatory Issues Facing Microfiltration and Ultrafiltration Steven C. Allgeier, USEPA **2001 AWWA Membrane Conference Proceedings.**	More regulatory requirements and integrity monitoring.
WaTER, Water Treatment Cost Estimation Program Michelle Chapman, USBR	Costs for disinfection and cartridge filters.
Energy Management Aurora, Harsh and LeChevallier, Mark W. JAWWA 90:2:40 (Feb 1998)	Energy efficiency in water treatment plants.
BOWERS POWER SYSTEMS www.bowerspower.com	Generator information.
USDA RUS	

Data and Documents Consulted

Title, Author, and Date	Information
www.usda.gov/rus/water/ees/energy.htm	Energy management
Preliminary Engineering Report **Blackfeet Community Water Project** Justin Wieser, Project Engineer Carole Boerner, PE	Blackfeet Community Water Project projections, estimates, justifications and financial term costs, review of identified alternatives.
Environmental Assessment **Project Number BI 99-840** **Blackfeet Nation** **Blackfeet Community Water Project** By Hydrometrics, Inc.	Environmental Assessment, complete document, for the Blackfeet Community Water Project.
Cultural Resource Inventory **Blackfeet Community Water Project** **Final Report** By Ethos Consultants	Cultural Resource Inventory and assessment with recommendations for the Blackfeet Community Water Project.
Blackfeet Community Water Project **Specifications for Construction of** **Lower Two Medicine Water Intake** **Phase I** By: Thomas Dean & Hoskins, Inc.	Intake pipelines, casings, technical drawings and specifications.

Design Team Presentation Attendance List
September 24, 2001 - 9:30 a. m.

Name/Title/Discipline	Address/Phone Number
Mr. Ted Hall Value Study Team Leader Civil Engineer	Bureau of Reclamation, Pierre Field Office 810 West Fifth Street, Pierre SD 57501 Phone: 605-945-2980 Ext. 3003 Fax: 605-945-2969 E-mail: thall@gp.usbr.gov
Ms. Karen Bucklin-Sanchez, PE Engineer, Rural Utilities Service	USDA MT Rural Development 900 Technology Boulevard, Suite B, Bozeman, MT 59718 Phone: 406-585-2528Fax: 406-585-2565 E-mail: karen.sanchez@mt.usda.gov
Mr. Jason Lovett, PE Senior Environmental Engineer	Indian Health Service4020 Wheaton Way, Building B, Suite L, Bremerton, WA 98310Phone: 360-792-1235 F E-mail: jason.lovett@mail.ihs.gov
Mr. Stewart Miller Project Manager	Blackfeet Community Water Project Quarters 108 N. Government Square, Browning, MT 59417 Phone: 406-338-7406 ext. 368 Fax: 406-338-7426 E-mail: ssm@3rivers.net
Mr. Dan Carney Biologist	Blackfeet Fish and Wildlife N. Government Square, Main Tribal Building, Browning, MT 59417 Phone: 406-338-7207 ext. 317 Fax: 406-338-7530 E-mail: dcarney@3rivers.net
Mr. John Monroe Project Coordinator	Blackfeet Housing 635 S. W. Boundary, Browning, MT 59417 Phone: 406-338-5031406-338-2241 E-mail: jmonroe.@3rivers.net
Mr. Robert DesRosier Director	Blackfeet Utilities N. Government Square, Main Tribal Building Browning, MT 59417 Phone: 406-338-7667 ext. 302 Fax: 406-338-7451 E-mail: rjdrosi@3rivers.net
Ms. Michelle Chapman Physical Scientist	Bureau of Reclamation, PO Box 25007 (D-8230), Denver, CO 80225-0007 Phone: 303-445-2264 Fax: 303-445-6329 E-mail: mchapman@do.usbr.gov
Mr. Dennis Baker Director of Engineering	Glacier Park Inc. 1 Midvale, East Glacier, MT 59434 Phone: 406-226-5528 Fax: 406-226-9332 E-mail: baker@3riversnet
Ms. Carol Boerner Senior Environmental Engineer	Indian Health Service PO Box 760 Browning, MT 59417

Design Team Presentation Attendance List
September 24, 2001 - 9:30 a. m.

Name/Title/Discipline	Address/Phone Number
Mr. Justin Weiser Engineer	Indian Health Service PO Box 760 Browning, MT 59417

Value Study Team Presentation Attendance List
September 28, 2001 -11:00 a. m.

Name/Title/Discipline	Address/Phone Number
Mr. Ted Hall Value Study Team Leader Civil Engineer	Bureau of Reclamation, Pierre Field Office 810 West Fifth Street, Pierre SD 57501 **Phone:** 605-945-2980 Ext. 3003 **Fax**: 605-945-2969 **E-mail:** thall@gp.usbr.gov
Ms. Karen Bucklin-Sanchez, PE Engineer, Rural Utilities Service	USDA MT Rural Development 900 Technology Boulevard, Suite B, Bozeman, MT 59718 Phone: 406-585-2528Fax: 406-585-2565 E-mail: karen.sanchez@mt.usda.gov
Mr. Jason Lovett, PE Senior Environmental Engineer	Indian Health Service4020 Wheaton Way, Building B, Suite L, Bremerton, WA 98310Phone: 360-792-1235 F E-mail: jason.lovett@mail.ihs.gov
Mr. Stewart Miller Project Manager	Blackfeet Community Water Project Quarters 108 N. Government Square, Browning, MT 59417 Phone: 406-338-7406 ext. 368 Fax: 406-338-7426 E-mail: ssm@3rivers.net
Mr. Dan Carney Biologist	Blackfeet Fish and Wildlife N. Government Square, Main Tribal Building, Browning, MT 59417 Phone: 406-338-7207 ext. 317 Fax: 406-338-7530 E-mail: dcarney@3rivers.net
Mr. John Monroe Project Coordinator	Blackfeet Housing 635 S. W. Boundary, Browning, MT 59417 Phone: 406-338-5031 Fax: 406-338-2241 E-mail: jmonroe.@3rivers.net
Mr. Robert DesRosier Director	Blackfeet Utilities N. Government Square, Main Tribal Building Browning, MT 59417 Phone: 406-338-7667 ext. 302 Fax: 406-338-7451 E-mail: rjdrosi@3rivers.net
Ms. Michelle Chapman Physical Scientist	Bureau of Reclamation, PO Box 25007 (D-8230), Denver, CO 80225-0007 Phone: 303-445-2264 Fax: 303-445-6329 E-mail: mchapman@do.usbr.gov
Mr. Dennis Baker Director of Engineering	Glacier Park Inc. 1 Midvale, East Glacier, MT 59434 Phone: 406-226-5528 Fax: 406-226-9332 E-mail: baker@3riversnet
Ms. Carol Boerner Senior Environmental Engineer	Indian Health Service PO Box 760 Browning, MT 59417

Value Study Team Presentation Attendance List
September 28, 2001 -11:00 a. m.

Mr. Justin Weiser Engineer	Indian Health Service PO Box 760 Browning, MT 59417
Mr. Richard Oksness Construction Branch Chief	Billings Area IHS 2900 4th Ave. N., PO Box 36608 Billings MT. 59101 Phone: 406:-247-7096 richard.iksness@mail.ihs.gov
Mr. Leo Kennerly Blackfeet Tribal Council	Blackfeet Tribe Browning, MT 59417 Phone: 406-338-7179
Ms. Marilyn Parsons Planning Director	Blackfeet Planning and Development PO Box 2809; Browning, MT 59417 Phone: 406-338-7181
Mr. George Heavy Runner Planning Department	Blackfeet Planning and Development PO Box 2809; Browning, MT 59417 Phone: 406-338-7181
Mr. Mike LaMere TPA Grant Writer	Blackfeet Planning and Development PO Box 2809; Browning, MT 59417 Phone: 406-338-7181 kyio@excite.com
Mr. Titus Upham BTBC	Blackfeet Tribe Browning, MT 59417 Phone: 406-338-7179
Mr. Mitch Copp Program Director Rural Utilities Service	Rural Development PO Box 800; Bozeman, MT 59771
Mr. Stanley Faught Rural	Rural Development/Rural Utilities Service 3350 Mullan Rd., Suite 106 Missoula, MT 59808 406-829-3395
Mr. William Morris Mayor of Browning	Town of Browning PO Box 469; Browning, MT 59417 Phone: 406-338-5917 willym@3rivers.com
Mr. William P. Grant AIA President	East Glacier Water & Sewer District East Glacier, MT 59434 Phone: 406-226-4461 (District) 406-226-9230 (Office)

APPENDIX